SCIENCE

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*PROGRESS IN PHYSICAL CHEMISTRY.**

IN these days of far-reaching specialization the would-be speaker upon any subject is between a new Scylla and a new Charybdis. In order that his production should be comprehensible to those outside of the specialty it must almost inevitably be made boresome to those within the fold; but, on the other hand, that which is new to the specialist in his own topic is apt to be quite too new to the layman. Either popularizing or specializing is likely to wreck the speaker's purpose by inducing at least a part of his audience to slumber, and this danger is especially imminent after dinner on a hot day which has been filled with mental effort. In this brief address, which Professor Smith has entrusted to my care, I shall probably run foul of both obstructions; but this irregular course will have the great concomitant advantage of permitting each class of hearers to obtain a few minutes of much needed repose.

We are rather accustomed to look upon physical chemistry as being a very modern invention, and in one sense we are not wrong in so doing. But after all, many of the fundamental generalizations of physical chemistry are by no means recent, and some of them are really old. Leaving out of account the probable discoveries in the

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subject made by Adam and Eve in the Garden of Eden, it is certain that the philosophers and alchemists were as much interested in those phenomena which lie on the border-line between physics and chemistry as in those which were purely physical or chemical. Indeed, the sharp line between the two subjects, drawn with so much emphasis twenty or thirty years ago, did not then exist. It is interesting to note that this sharp line is now rapidly being erased; we are realizing more and more that the laws which govern one class of phenomena are applicable also to the other. Thus the cosmic working of the mind of man swings back and forth; will it ever come to rest upon the absolute truth?

In the middle of the seventeenth century, while this country was in an infantile condition, and Harvard College was little more than embryonic, Robert Boyle discovered his law relating to the contraction of gases under pressure—one of our most fundamental conceptions to-day. Lavoisier, before his tragic death in the Reign of Terror, forced upon a somewhat reluctant world the idea of the conservation of mass—an idea which perhaps had been half assumed by some before—and in so doing laid a corner-stone of the great structure which was to follow. Only a few years later, Dalton, Avogadro, Ampère, Gay-Lussac, Dulong and Petit, Davy and Faraday, that prince of pioneers, with others less famous, made great additions to the world's thought in a physico-chemical direction. As far back as our forties Julius Robert Mayer and Helmholtz had acquired a clear grasp of the conservation of energy, while the other great law of energy had been partially realized by Sadi-Carnot two decades before. Hittorf's classical research on electrolytic conductivity, and Wilhelmy's epoch-making study of the speed of a reaction, a research upon the lines laid down by Wenzel and Berthollet so much earlier, took place over forty years ago. Only a decade later Guldberg and Waage laid down, in unequivocal and comprehensive terms, the fundamental law of mass-action, which is the basis of Wenzel's, Berthollet's and Wilhelmy's observations, as well as of the progress and equilibrium of every other chemical change.

Why, then, with these foundations laid so far in the past, are we inclined to call physical chemistry a brand-new structure?

We all know that a part at least of the retarded development was due to the difficulty of dealing with solutions, which seemed anomalous in so many ways. Van't Hoff, by showing that a substance in solution followed many of the laws which would govern it in the aëriform state, and Arrhenius, by explaining, in a simple way, the differences between solutions conducting electricity and those which are non-conductors, cleared the track of these obstructions; hence, for the last ten years the pace has been rapid. But it seems to me that there is another reason for the tardiness of the recognition of the importance of physical chemistry to be found in an unfortunate tendency observable sometimes in both chemists and physicists, a tendency which I am afraid we must call prejudice. Not only have untenable theories been held long after their time, but whole fields of study have been neglected by most chemists and physicists, because they lie on the border-line between the two sciences.

The average physicist only half realized that one of the most important relations of his great new force, electricity, is chemical, while the chemist does not always realize, even to this day, that Wheatstone's bridge and the telephone are chemical tools just as legitimate as, and no more 'physical' than the thermometer, or the time-honored balance, which extricated his predecessors from so hopeless a slough a hundred years ago. The day is fast approaching, however, when

both chemist and physicist will welcome every mode of acquiring more light upon the absorbing topic which engages them in common—the study of the ultimate laws and structure of the universe.

It is a pleasure to think that one of the foremost of the brilliant men who have joined in advancing this wished-for end—this union of the resources of physics and chemistry to a common purpose—since the last meeting of the American Association has had his services recognized and his opportunity enlarged by his own University of Leipzig. Wilhelm Ostwald's new laboratory for physico-chemical research is the second important university building for this purpose which has been erected in Germany, the first having been built at Göttingen for the brilliant Walther Nernst; and the fact that Ostwald should at last have obtained a material outfit worthy of his unusual mental equipment is welcomed with enthusiasm by his many warm friends. We all know what a profound effect Ostwald's surprising book, his timely Zeitschrift, and in general his broad and progressive point of view, have had upon the development of both chemistry and physics, and it has been a matter of some surprise to many that so great an influence should have emanated from a laboratory so insignificant as the old Zweitem Laboratorium, so called. The new building, although not very large, is in many respects a model; the architect and director of any kind of scientific workshop could not fail to obtain valuable hints from the detailed statement of it contained in the recently published appendix to the Zeitschrift für physikalische Chemie. What a pity that America should allow Germany to outstrip us so far in devotion to the ideals of pure science! How long will it be before we build laboratories especially for physical chemistry, or even in many colleges allot a considerable share of old buildings to this end? And yet this physical chemistry now comprehends all of the field of theoretical chemistry, except a certain kind of reasoning concerned with the structure of organic substances, and the purely chemical part of the mysterious classification called the periodic system of the elements.

Very few of the processes of nature are simple in their proximate causes or their outward manifestations, however simple the grand underlying principles may be in their ultimate essence. The old maxim, by which theories were so often consciously or unconsciously judged, 'Our theory is so simple that it must be true,' is a dangerous guide. Geber's old notion that the whole world consists of sulphur and mercury, and the topsy-turvy delusion of phlogiston, relied largely on this maxim for support, and it behooves us to avoid similar mistakes. When the ancient idea of luck had been eliminated from scientific reasonings mankind admitted that every phenomenon is a function of its controlling causes; but that all the mathematical relations should be capable of solution, although to be sure only with the aid of the potent modern methods, is a new conception. In the old days problems in chemistry which could not be solved by simple arithmetic, or at best by elementary algebra, were considered incapable of quantitative solution; now, the higher mathematics is a facile tool in the hands of many an eager chemist. Even that mystery of mysteries, the smallness of the yield in the preparation of organic substances, has a flood of light shed upon it by the phase-rule and the mass-law!

No one who is familiar with the facts can doubt that the mathematical point of view will prove in the future more and more useful to chemists, as well as to the new physical botanists and zoologists, who are bringing it to bear on their transcendently recondite problems. These last-named investigators will follow in the footsteps of

chemists, as chemists have followed in the footsteps of physicists.

The advance of the mathematical point of view in chemistry has brought with it an entirely new danger, as well as a new field of power. The accuracy of a result, of course, depends upon the accuracy of the foundation upon which the reasoning rests; and accurate mathematical processes may lead to wholly erroneous conclusions if they are based upon incomplete data. In chemistry this cause of error is especially prominent, because of the great complexity of most of the phenomena and the fact that they are often modified by subordinate influences. For this reason a physicist, used to simple phenomena and less complex effects, is especially apt, when he deals with problems allied to chemistry, to erect a large superstructure of mathematical reasoning possessing the semblance of reality upon a paper foundation, and be drearily awakened some fine day by the collapse of his air castle. The only mode of guarding against this subtle cause of disaster is to bring as much skill into every step of the experimentation as into the pure reasoning based upon the supposed facts. Here the physicist is seriously hampered by his lack of knowledge of chemistry, as well as by his usual repugnance to dealing with glass vessels and liquids; while, on the other hand, the chemist is equally hampered by his inbred dislike of brass instruments and his imperfect acquaintance with the manipulation of his new sensitive tools.

In short, one must be an accomplished chemist, physicist and mathematician in in order to attain the highest results in modern theoretical chemistry, and the number of men who have the time or ability to acquire this threefold education can never be large. All honor to van't Hoff, Ostwald, Nernst and the others who come nearest the high ideal! While it is true, however, that few men can hope to attain the highest, it does not follow that the rest of us cannot be of great use. Each man can be of value in his own particular sphere; it is only necessary that he should work faithfully with a single eye to the truth, that he should be as free as possible from prejudice, and that his published work should be as accurate as he can make it. A well conducted organic synthesis, a few carefully determined solubilities, will in the end be more valuable to the progress of science than a false generalization, no matter how ingenious the latter may be. But how great is the responsibility of the collector of facts! for if his observations are false his work is of less value even than that of the false theorist; it has not even ingenuity in its favor, and is worse than useless. Ostwald has more than once pointed to the responsibility attending publication, and we should all do well to heed his warning.

A comprehensive design which I had once harbored of giving you a *résumé* of the year's work in physico-chemical research throughout the world has been relinquished because of the great number of small papers which could not be treated satisfactorily in the brief space of an evening's talk. The subject of stoichiometry, in Ostwald's rather comprehensive interpretation of this word, has received this year the attention usually accorded to it. Solutions have still occupied many able men, without having by any means had their possibilities exhausted. Van't Hoff's admirable little book upon double salts has already begun to exercise an effect upon the chemical world which the scattered and less illuminating papers of his students could not have been expected to exercise. Dr. Gibbs' interesting address upon this important topic will undoubtedly excite further study on the whole question of the so-called 'molecular compounds,' which are so little understood and so hard to reconcile with our only partially satisfactory ideas of quantivalence. The

far-reaching subject of chemical equilibrium is receiving more and more attention every year. There has been great activity in the fascinating field of electrochemistry, and it is pleasing to see that some of the fundamental notions of this new science are coming to be recognized by the analyst and the technical chemist. Not least among the startling events of the year had been the supposed discovery of a number of new elements, crypton, neon, metargon, coronium and etherion ; if these really exist, we have here a series of brilliant chemical discoveries made solely by means of physical instruments and operations.

The most important of these interesting investigations are undoubtedly as well known to you as to your speaker, for in this day the sources of information are equally open to all; hence it would be a work of supererogation for me to discourse upon them in detail, even if there were time to do so. I prefer, therefore, to call your attention to some unpublished work with which you can hardly be so familiar ; I mean the physio-chemical problems which have enlivened the last winter's laboratory work at Harvard. Since these covered a somewhat extensive field their exposition may serve the double purpose of illustration and information. It is a pleasure to state that most of these researches would not have been thought of without the inspiring example and precept of the great men of whom I have spoken. The host of interesting investigations thus prompted in all civilized lands afford the best possible proof of the value of the modern physico-chemical hypotheses.

Dr. Gordon, the Harvard assistant in physical chemistry, has finished a very interesting series of measurements of the potentials of galvanic cells composed of metallic plates immersed in fused salts at high temperatures. After overcoming experimental difficulties, too numerous to mention, he succeeded in obtaining constant values which agree remarkably with Nernst's formula and throw interesting light on the degree of dissociation existing in fused salts.

Mr. Edward Collins has nearly finished an elaborate attempt to verify Faraday's law with rigid exactness, an attempt which has met with greater success than any previous one.

Mr. G. N. Lewis made a series of careful measurements of the change of the potential of numerous reversible electrodes with the temperature, as well as a comprehensive revision of Meyer's inaccurate work on concentration cells involving amalgams of different strengths. In the thermodynamic discussion of the results Mr. Lewis arrived at some very interesting conclusions concerning strong as well as weak solutions of metal in mercury, and extended his experiment and mathematical analysis to the consideration of the potential of the unamalgamated metal in a solution of one of its salts. It is needless to say that this question is one of wide significance, but lack of time prevents my doing more than call attention to it now. Mr. Lewis's preliminary paper will appear early in the fall.

Mr. F. R. Fraprie spent much time in studying the eccentricities of inversion temperatures and transition intervals exhibited by the double sulphates of potassium and manganese. This problem proved to be far more complex and interesting than the similar case involving magnesium instead of manganese, a case which has been so carefully investigated under Van't Hoff's supervision. While Mr. Fraprie was not able to push the matter to completion he obtained data enough to enable one to plot many of the most essential curves and to draw a mental sketch of the situation. It is hoped that this work may be continued during the present year.

Mr. Faber, in the course of a research having a more practical end as its chief

aim, made a series of determinations of the solubilities of argentic halides in solutions of sodic thiosulphate, and obtained data which may be of use in determining the mechanism of this reaction. Messrs. Harrington and Henderson made a few interesting observations on some cases in which the dissolving of a solid in a solution caused a lowering instead of a rise in the boiling point, and Mr. Churchill made a careful determination of the melting point of crystallized Glauber's salt. The aim of this last labor was to secure a new fixed point for the standardizing of thermometers, and we succeeded in showing that the point was as easily obtained and as constant at 32.484° as could be desired. This means of verifying thermometers will be a great boon to those who have not a standard instrument at hand. The paper will appear in the September numbers of the *Zeitschrift für physikalische Chemie* and the *American Journal of Science*.

Besides these varied researches, a protracted study of the causes of the occlusion, and the unequal release of gases by the oxides of metals formed from the nitrates, occupied most of my spare time. It became evident that the excess of oxygen usually present in such material has a tendency to work its way out by a process of dissociation and recombination which reminds one of the old-fashioned explanation of electrolysis. The nitrogen, not being able to escape in this fashion, is retained. This paper has just appeared in the Proceedings of the American Academy.

In addition to these, several other researches were also in progress, which, although they belong strictly to the domain of inorganic chemistry, would never have been undertaken but for the theoretical interests involved. Prominent among these were the revisions of the atomic weights of cobalt, nickel, uranium, strontium and calcium, undertaken by Dr. Cushman, Messrs. Baxter and Merigold, and myself.

Of course, it sometimes happens that physico-chemical problems involving the use of complicated apparatus may be more readily solved in a physical than in a chemical laboratory, and in any case the cooperation of these two departments is highly advisable. I am happy to say that Dr. Duane and others have been conducting such chemico-physical investigations at the Jefferson Physical Laboratory of Harvard College, but of these I have no authority to speak.

When one has been discussing the past and present progress of any subject it is natural that the mind should turn to the future also. What fields are likely to prove the most fruitful in the years to come? What researches will probably best advance the interests of science and, therefore, of the life of man? Prophecy is always an uncertain business, but if one recognizes the uncertainty it has few dangers and becomes at least amusing. In this case, however, it presents few difficulties.

The whole field of physical chemistry is so fruitful when treated by modern methods that one can hardly single out any section as especially unpromising. Almost every subject is worthy of research; a more important question is the *spirit* in which the research is to be undertaken.

There have always been two parties as regards any question brought forward by mankind for discussion—the conservative party and the radical party. The former has a tendency to cling to old ideas simply because they are old, and the latter has a tendency to adopt new ideas simply because they are new. It seems to me that neither of these tendencies is legitimate. One should seek new points of view continually, but he should hold to that which is good until something is proposed which seems to him better. In every case he should weigh the respective arguments for and against

the new point of view with a mind as free as possible from prejudice, and with a single eye to the truth. In short, the ideal investigator is the scientific independent, the chemical 'mugwump.' It is too unreasonable to hope that the problems of the twentieth century will be dealt with in this thoughtful but untrammeled fashion?

We Americans rejoice in having on our side of the ocean the world-renowned names of several great men, of Wolcott and Willard Gibbs, of James Crafts, Edward Morley, the late Josiah Parsons Cooke and others, who have combined chemistry with physics and mathematics; but, nevertheless, one must admit that America has not done as much as one could wish toward building up the fabric of modern physical chemistry. Although science is world-wide, and scientific men should be cosmopolitan, the existence of this Association proves that there is a patriotic side to the matter too. While welcoming the truth, wherever it is discovered, let us then do all we can to further its emanation from American laboratories and writing desks.

THEODORE W. RICHARDS.
HARVARD UNIVERSITY.

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*A CENTURY OF PERSONAL EQUATIONS.**

IN 1795 Maskelyne, Astronomer Royal at Greenwich, discovered that his assistant, Kinnebrook, was in the habit of noting star transits about seven-tenths of a second of time later than himself, and discharged the poor fellow as 'vitious' in his method of observing. The matter attracted little attention until, about twenty-five years later, the celebrated Bessel investigated it, and showed that the best observers whom he could influence exhibited similar discrepancies in their transits. Bessel himself was exceptionally early in his times, and found that other astronomers were usually later. The theory which he formed was that the early observers, Maskelyne and Bessel himself, heard their clock beats before they saw the stars' images, while the late observers, Kinnebrook, Argelander, W. Struve and others, saw first and then heard. The theory of Bessel has been generally adopted by astronomers and psychologists, and the investigation of the differences between astronomers has been pursued pretty continuously since 1836, when Airy, as Astronomer Royal at Greenwich, began a regular continuance of Bessel's investigation soon after entering upon that office. The matter was more or less perplexing to the Greenwich observers for the twenty years between 1836 and 1855. In 1853 the so-called eye-and-ear method, which had been employed for about a century previously, was laid aside at Greenwich for most purposes, and replaced by the American, or chronographic, method of galvanic registration, invented by Sears Cook Walker in 1849.

During the first half of the century, 1795 to 1895, to which this paper refers, observations of transits were made by Bradley's method, or by eye and ear, but for the second half century observers have had the benefit of Walker's invention, and of the ingenious apparatus constructed by the Bonds and other mechanicians for the purpose of carrying out the principle introduced by Walker. The investigations of personal equation up to 1853 are based, then, upon experimental psychology as developed by Bessel, and have led to a pretty complete body of empirical facts in that direction. But Bessel and his associates considered the whole matter enigmatical and difficult to trace, owing to the fact that the phenomena are subconscious and not easy to bring under the laws of experimental science. Observers noted large differences in their times, a second or more, and could not reduce them to moderate

* See also my article in SCIENCE for Nov. 26, 1897.

amounts by long practice. A second of time in longitude amounts to fifteen hundred feet on the map if the place be near the equator, so that, all told, the elimination of personal equation is one of the most important and perplexing problems of practical astronomy.

The matter became more easily handled on the introduction of the chronograph in 1849, for several reasons. In the first place, the Greenwich observers found that by the new method the personal equations were diminished in amount in a general way. Sir George Airy, in his report for 1854, sums the matter up in these words:

"This apparatus, the chronographic, is troublesome in use, consuming much time in the galvanic preparation, the preparation of the paper, and the translation of the puncture indications into figures." And in his report for 1855 he also says: "The magnitude of the personal equation in the galvanic-touch method is not above half of that in the eye-and-ear method." But among the observers who use it there is but one opinion on its astronomical merits, that in freedom from personal equation and in general accuracy it is very far superior to observations by eye-and-ear method. This judgment of Airy's, however, needs some slight modification, according to the opinions of many of the best practical astronomers now living, and it is worth while to look at the other side in order to see if the eye-and-ear method should be kept up in active practice. First of all, as a method of training young observers it has some importance, as the apparatus is greatly simplified if the galvanic connections and preparation are eliminated. It is also often necessary to make time observations at so great a distance from civilization that the delicate chronograph is better left behind. This is a practical difficulty I have often experienced in geographical work in New Mexico and other distant portions of the United States; no chronograph was furnished me, and it was possible to fix the position of a corner post of Wyoming without a chronograph with an accuracy quite unusual in the U. S. Land Office at that time. Similar considerations were of importance in the geographical mapping work of the U. S. engineers, where the so-called station error or irregularities in the surface of the geoid far exceeded any errors arising from the use of the eye-and-ear method. After the great Chicago conflagration of 1871 it was a piece of good fortune that I could use the eye-and-ear method, as I was engaged in geographical operations for the U. S. engineers, who did not then possess a sufficiently complete supply of chronographs. In 1868 began the observations of the great international star catalogue of the Astronomische Gesellschaft, which is now approaching completion after thirty years of steady observation. At that time the Council of the Society were undecided as to the use of the chronograph in their catalogue, and its use or non-use was left to the discretion of the observers. In my own case I decided to begin without one, as the Chicago Observatory, where I then was, had not provided money for it, and the chronograph now used by my friend, Professor Hough, at his new observatory at Evanston, was constructed later. The conflagration, in its consequences, put an end to my work upon a zone of the A. G. C., and the zone continued at Lund, Sweden, by an appropriation from the Swedish government, and is, I suppose, nearly completed; but I went far enough, by the eye-and-ear method, to satisfy myself that it would have been entirely practicable to go on and satisfy the requirements of the Council as regards accuracy. At Harvard College Observatory my lamented friend, Professor W. A. Rogers, used an excellent Bond chrono-

graph, and completed his zone about a dozen years ago. Other observers decided for themselves whether or not to employ the chronograph, with the general result that with it the zone would be rather more accurate on the surface, and without it would be rather more promptly completed. When I say rather more accurate on the surface I mean that chronographic registration appears to be especially liable to a peculiar form of personal equation, viz.: a variation of the time of transit and, consequently, of the resulting right ascension, when the star is fainter than the ordinary stars observed for clock correction. This matter was pointed out originally as essential to be investigated, but has not yet been fully cleared up. So far as chronographic observations are concerned, there seems to be no doubt that the effect of faintness upon the time of transit is to delay the reaction or registration very generally, if not absolutely without exception. But, on the other hand, there are several observers, Argelander, Bauschinger, Deichmüller, Copeland and Börgen, for whom stars near, but below the limit of easy observation, with the instrument employed, are observed by Bradley's method earlier than brighter stars, while the same observers note the transit of stars near this limit, but above it, quite normally. This feature of his own observations was detected by Argelander himself, and confirmed by Auwers in his careful discussion of his own Berlin zone, in which the Bonn observations are taken into account.

As the phenomenon detected by Argelander in his own observations was referred to a psychical cause, it is likely that other observers might become aware of a similar phenomenon in their own observations, if it were not that the differences are trifling and liable to mislead the investigator who shall attempt to reproduce them, as is sufficiently apparent when the attempt is made to introduce a strict logical order into the statements already published.

Personal equation is a subject so different in its causes from the ordinary instrumental peculiarities which manifest themselves in results that the causes of it, which are psychical, are entirely liable to be mistaken and thus obscured, and entirely trustworthy results are liable to be rejected as abnormal, because they do not agree with groundless hypotheses. Suspicion has been expressed, for example, that Nyrén's latitude observations, with the prime vertical transit of the Pulkova Observatory, are liable to an equation of a personal nature depending upon the magnitude of the star observed. The suspicion was based upon the theory that the chronographic and eye-and-ear methods have some elements in common, which rendered them equally liable to such a form of personal equation, while the fact is that the general phenomena of personal equation by eye and ear are due to the cause detected by Bessel, viz.: the 'Zeitverschiebung,' or displacement of time, which arises when the attempt is made to add an impression on the sense of hearing to one at exactly the same instant on the sense of sight. In the chronographic method of registration the time required is in normal instances positive—that is, the 'reaction' time of the psychologists. The two methods of observing transits are psychically different, and the general result for ordinary time stars is that the average chronographic observer produces transits about as much later than the average eye-and-ear observer as is required for a simple reaction. The amount is 0.162 at Greenwich for the ten years 1885 to 1890, inclusive, and 1890 to 1894, inclusive, with trifling fluctuations (see my paper in No. 425 of the *Astronomical Journal*). Since writing that I have received the introduction to the Greenwich Astronomical Observations for the year 1895, which gives a result almost identical with the years from

1885 on; for 1895 we find $e' - e = 0^s.161$ for 13 observers in all. The difference $-0^s.001$ between the mean for ten years and that for the single year 1895 is far less than the probable error about $\pm 0^s.002$ of the mean for 1895, a decided indication that the quantity $0^s.16$ is obtained with substantial accuracy from the ten years' results, and represents something which arises from a true cause or combination of true causes. A persistent positive sign of the quantities $e' - e$ is due, as it seems, to the fact that the chronographic transits are registered too late, combined with the other fact that the eye-and-ear observations are for some observers too late and for other observers too early. In order, then, to obtain the true time of a series of transits, the chronographic method, if employed by all the Greenwich observers, would give an average time too late by about $0^s.16$, while the eye-and-ear method would give an average time $0^s.16$ earlier and more nearly correct. We may suppose, for example, that in 1895 the 13 observers whose eye-and-ear personal equations are discussed in the introduction for that year have observed each a star of the average magnitude of a Greenwich time star, and in a moderate declination near the average declination of time stars, and, reducing the observations in the usual way, have obtained a clock correction by each method, but without the application of the personal equation. The average of the thirteen chronographic clock corrections would then be $0^s.16$ too small, while that of the thirteen eye-and-ear clock corrections have no common error constant for the thirteen. The standard observer for 1895, Mr. Lewis, obtained by eye and ear a clock correction $0^s.10$ larger than by chronographic on three nights in that year, and hence, so far as these three nights show, his eye-and-ear transits are more nearly correct than his average chronographic clock corrections, as we cannot well infer that the actual reaction time occupied in the bisection is very far from $0^s.16$. For a series of ten years in all the two-method equation for Mr. Lewis has been $0^s.139$ in the mean or for separate years as follows:

1885 + 0.06
1886 + 0.13
1887 + 0.13
1888 + 0.19
1889 + 0.15
1890 + 0.15
1891 + 0.09
1892 + 0.19
1893 + 0.20
1895 + 0.10

No eye-and-ear observations were recorded for Mr. Lewis in 1894, and the largest difference from the mean, viz.: $-.079$ for 1885, is not as large as the corresponding difference $-.089$ for the chief assistant, Mr. (now Professor) Turner, for the same year. The probable error of a year's determination for Mr. Lewis is $\pm 0^s.033$ by the sum $0^s.37$ of the ten differences from $\pm 0^s.031$, and by sum of squares the mean error is ± 0.047 and the probable error $\pm 0^s.031$. The important question whether there is in general a variation of personal equation with magnitude has already been tested in a good many ways by various astronomers, with the general result that such variations are far more uniformly exhibited in chronographic transits than in those taken by eye and ear. The investigations of the effect of such a personal equation have been carried on for the following zones of the Catalog der Astronomischen Gesellschaft, already published:

	Place	Observer
Zone 1° to 5°	Albany	Boss
15° to 20°	Berlin	Auwers
20° to 25°	Berlin	Becker.

There are various other investigations for chronographic observers which all agree in general with the result of the reaction

experiments in psychological laboratories, viz. : that the time of reaction, like that of chronographic registration, is lengthened when the impression on the sense is faint. But for eye-and-ear transits the experiments with screens are so far few and somewhat indecisive, and the phenomenon detected by Argelander, viz.: an anticipation of the transit of a star faint enough to be a little difficult of observation, has been noticed by several observers and tested in various ways.

The suspicion is expressed in Number 369 of the *Astronomical Journal* that the variation of personal equations with the magnitude of the star observed affects equally eye-and-ear observations and those made with the chronograph.

But on reading over the article in question it is at once noticed that there is great lack of detail in the result quoted, and that the direct determination by Becker shows an anomaly which the author of the article in *Astronomical Journal* No. 369 is confessedly unable to account for. A careful reading of Becker's investigation in his Berlin zone shows that the observations were made with Professor Becker's well-known skill and care, and whatever difficulty there may be in reconciling these results with other observations is probably due to the treatment of the latter, and hence that the lacking details in *Astronomical Journal* No. 369 would, if supplied, perhaps account for the discrepancy.

The author of the article quoted has not, so far as it appears, used his conclusions in his later important investigations. Even his rather hasty decision in favor of such a variability of eye-and-ear personal equation with magnitude deserves careful study as to the facts involved.

I venture to suggest a line of observation which I desire to see carried out, and which will add to the certainty of these conclusions.

The Christiana zone 64° 50′ to 70° 10′ of the A. G. C. has been long completed by the late Professor Fearnley, by whom the transit observations were made by eye and ear, and his successor, Professor Geelmuyden, who made the observations for declination and most of the reductions. The observations for right ascension are liable to but small casual errors, and have, I believe, been shown to be nearly free from constant error due to the faintness of the stars below the magnitude at which they are easily observable. The stars of this zone below a certain magnitude, for which I may assume 8.2 of the B. D. scale, might be reobserved to some advantage in connection with a similar reobservation of Groombridge's stars, which is now going on at Greenwich. In order to conduct such reobservation to the best advantage, all things considered, I should confine it to those stars in Groombridge's catalogue which are within 25° of the pole for the epoch 1875, as the meridian circle in my charge has an aperture of four and one-half Paris inches, and there are very few of Groombridge's stars which it cannot easily reach, as I know by long experience with it. The few Groombridge stars, if there are any such, which would give any trouble with the Williams College circle to reobserve, are those which Groombridge picked up on exceptionally clear nights, but they are included in the Radcliffe Catalogue, whose right ascensions were observed with an aperture of considerably less diameter. The cases will be very few in which Groombridge's stars will not be easily observed on any good night with the aperture of 122 mm., and in which the observer would be liable to the 'Argelander phenomenon' or reversal of the ordinary order of sensations as shown in the cases of Argelander himself, Copeland, Börgen, Bauschinger and other good observers.

The difficulty of separating this form of

personal equation from other forms is very considerable. When the Greenwich catalogue for 1890 is published, it will be necessary to find out in some manner the personal error depending on magnitude of the chronographic right ascensions of that catalogue, but these will have in them a personal element depending on the habits of the observers by whom the transits have been registered, and this will be complicated unless it is shown that the various observers have been brought to a more uniform habit than is generally supposed. The comparison of the catalogue for 1890 with the zones of the A. G. C. will at a later time furnish a great amount of interesting information, but which at present needs the careful study of the methods of observation and elements of reduction which have been employed in the zones already observed by eye and ear as well as by chronograph.

The catalogue of Dr. Romberg* is the best standard of comparison for the A. G. C. eye-and-ear zones, as it was observed in the years 1874 to 1880 with a powerful meridian circle whose aperture was large enough to render all the A. G. C. stars distinctly visible, and the standard of reduction is the same as for the A. G. C., viz.: Wagner's right ascensions for 1865 and Nyrén's declinations for the same epoch.

Truman Henry Safford.
Williams College.

SOME DANGERS OF THE ABUSE OF CHEMICAL FORMULAS.

When Thomson made his memorable visit to Dalton, in Manchester, nearly one hundred years ago, and was shown the system of symbols by which Dalton hoped to make clear his ideas as to atoms and their combinations, he was enthusiastic as to the future usefulness of such a system. And, although the system was clumsy and inadequate to the task of properly representing the great mass of chemical facts, it contained the valuable idea of graphic representation which was to be ingeniously elaborated and developed by later masters of the science.

It was through Berzelius next that chemical symbols were made simpler and clearer. So manifest was their usefulness that they speedily claimed the additional advantage of almost universal acceptance. Local adoption only, the use by chemists of one nationality or the followers of one master would have proved a most serious bar to the advancement of the science. We can fancy the confusion which would arise from the use of different systems at present, but, happily, such a picture exists in the imagination only. The science has one universal language of symbols which those of every tongue can read and understand. The advantages of such a system need not be dwelt upon. I purpose rather pointing out a few possible dangers and abuses.

The simple application of symbols in the time of Berzelius has become more complicated as the science has developed and the knowledge of both composition and constitution of chemical bodies has increased. Intended at first to represent elements and single compounds, the symbols have been developed into complex formulas, and these have been united into algebraic equations in the effort to make them represent as much as possible of the knowledge so laboriously acquired by multiplied experiments. The system has become in truth the shorthand of chemistry.

While its great usefulness is not to be underestimated, the limitations of the system should be duly recognized. In the first place, it can only partially represent the mathematical relations of the science. Again, there is no mode of indicating in an equation the physical forces which always accompany chemical reactions. These re-

* I regret to say that this excellent observer has passed away since these words were written.

lations are of especial importance and yet there is no adequate mode of expressing them. It is questionable how far such important relations as the electro-chemical and those of chemical affinity itself can be deciphered from those equations. Certain it is that the best constructed equation frequently represents only one of many reactions occurring at the same time and under the same conditions, and there is no way of indicating under what conditions the given equation is true. It often happens, especially in organic chemistry, that an equation upon which much stress is laid is really a secondary and subordinate one, and since this is not indicated by the formula the student may be mislead.

Such questions as whether all of these more or less desirable matters can ever be represented by any system, or whether the present system is not the most perfect which we can hope for, do not come within the scope of the present discussion. It is sufficient to point out that the system is not flawless. We must all acknowledge that it is indispensable to chemists and, being something more than a mere shorthand system, greatly aids him in his work.

For these reasons all young chemists must be properly initiated and inducted into the mysteries of the system so that they too may belong to the great order of the *illuminati*.

The great value of symbols and formulas in teaching chemistry is not to be questioned. Their use is essential to the imparting of a quick grasp and a clean mental picture of what takes place. But their abuse is quite possible, and I shall briefly point out some of the dangers which lie in this direction. It must be constantly borne in mind that these formulas do not constitute the science of chemistry, but are merely an abbreviated mode of stating some of the facts, while many do not admit of such concise, graphic representation. So much stress is sometimes laid upon these symbols, and so much store set by their manipulation, that the student may gather the impression that he knows and understands much of the science when he can glibly rattle off a few of them, and he may devote much time to memorizing certain of them which it were far better to spend in an attempt at grasping the great science itself.

It has occurred to me that it might be profitable to point out the following dangers of abuse:

1st. *The Danger of Methodism.* This is a danger common to much of the elementary teaching of the day. We have of late years many schools of methods established all over the country. These have their value in so far as they tell how knowledge may be imparted in an orderly, systematic, methodical manner, but great care must be exercised lest the method should be magnified above the knowledge and the student go away with the empty method alone. I have known such schools where the whole subject was made ridiculous by extended dissertations upon the proper posture of the child in reciting or in drinking water, or some equally subordinate matter where the time at command was too valuable for more than brief mention of such details. And so we can all doubtless recall text-books on chemistry where large space is given to the arrangement, manipulation or completion of formulas and equations. Sometimes they are placed before the pupil like a dissected map or puzzle, shaken together or with some missing member to be supplied, certainly giving him one false idea, namely, that such equations are to be worked out with pencil and paper where the effort should be to impress upon him the knowledge that such equations are legitimate only when they are the result of actual experiments and when proved in every particular by direct trial. Such juggling with

formulas may induce a certain ingenuity, but may also be positively harmful so far as the acquiring of true knowledge is concerned.

2d. *The Mathematical Danger.* The effort at placing chemistry upon a mathematical basis, and so making of it a true science, according to the German definition, is a laudable one, but this end is not to be obtained by a multiplication of problems based upon the time-honored rule-of-three and the simple algebraic transformations made use of in chemical problems. Enough of this sort of mathematical work should be given to make clear the great underlying laws of chemistry—the indestructibility of matter, the constancy of proportions, etc. Beyond this harm may be done to some minds not mathematically inclined.

A bright, ingenious mind may revel in some of the abstruse and difficult problems which have been based on this rule-of-three, while other minds may be frightened and confused. There is a temptation to a bright, mathematically inclined teacher to add to these problems and exercises, but I maintain that in such case he is attempting to teach mathematics, and not chemistry.

3d. *The Mechanical Danger.* Many have seen this danger and have given forth no uncertain note of warning against it. In graphically representing formulas, especially those of organic bodies, the mechanical limitations are such that there can be no adequate picture given. Much must be left to the imagination. The effort is only to give an outline or a few points upon which to fix the mental picture. But young minds are at times so hopelessly matter-of-fact, and one of the most difficult of tasks is to transfer the vision of your imagination upon the mental retina of others. In the first place, there is the blackboard with its plain surface and white trails of chalk dust. You are endeavoring to give a picture of some collection of wonderful symmetrical atoms bound together by strange, invisible emanations of force and endowed with marvelous properties and powers. How can you hope to do it with such means as are at your command? How can you devise mechanical means, balls, strings or rubber monstrosities which will properly aid you?

And yet, these mechanical aids are helpful, for mere word painting is far too vague for the purpose. Only beware lest the idea be given that your rubber or glass toys or scratches on the board really look like the incomparable atoms themselves, and that the chemical force displayed between them closely resembles a connecting wire or a bit of glass tubing or a streak of chalk powder.

4th. *The Danger of Idolatry.* By this I mean the placing of the formula upon the pedestal which belongs to the science itself. To my mind, next to the achievement of written language itself, the fully worked-out formula for a complex organic body represents the most wonderful accomplishment of the human mind. It is the result of years of toilsome experiment, of high theorizing and of ingenious logic. It is a building erected by some skilled artificer upon the delicate handiwork of other master-workmen, all resting on the foundation stones of the science laid with infinite care and labor. It is a mighty epic to man's capacity for faithful toil, for self-sacrificing coöperation, for concentration of thought, for ingenuity of eye and hand and brain, and to his love for and deep yearning after the truth.

Yet, with all this granted as true, do not let us fall down before our formula and worship it. It is but the work of our hands after all and *humanum est errare.* The worship of that which may desert us in the time of need is apt to lead to an unfruitful and unhappy skepticism, as the history of our science during the middle decades of this century bears witness. Let us rather

be prepared to erect another more beautiful because truer building if the first should be overthrown. It is truth that we seek after, and the building of our hands can never be truth itself, but at best only its fit temple.

I trust that I shall not be misunderstood in what I have said about these dangers. I am not an iconoclast, but wish only to plead for conservatism and moderation.

F. P. VENABLE.

UNIVERSITY OF NORTH CAROLINA.

THE VETTERN ESCARPMENTS OF SOUTHERN SWEDEN.

To a geologist a fault is always a fault. Whatever its age, whatever the present condition of the land, he reconstructs the dislocation in his mind's eye, and sees the break as vividly as though the action were going on before him. Not so, however, some physiographers. To them a fault is expressive only in its topographic sense; and just in so far as the dislocations can be seen on the surface do many of the students recognize their existence.

On the other hand, the geologist frequently fails to note two points of some importance; at least, he often neglects them in his writings. These are the age of the dislocation, and the form assumed by the land after faulting. While in many cases some attention is paid to these, it is very noticeable that the literature of faulted regions contains little of definite statement concerning them. A good illustration of the physiographic attitude is afforded by a study of the escarpments in southern Sweden which run east from the northern end of Lake Vettern to the Baltic. On the ground, the appearance is of a tolerably steep bluff from higher land on the north down to lower ground on the south. The main escarpment is fairly continuous except near the lake, and is formed of a series of leads and offsets at high angles. The connection between them and the joint systems elaborated by Mr. J. B. Woodworth at once suggests itself, but so far only a general resemblance has been established. The various planes in these examples are more irregular in direction and continuity than in the minute cases which are the basis of Mr. Woodworth's work.

The series may be divided east and west into two parts. That about the lake and for some distance east is characterized by having the angle of the notches face southwest and the sides making the angle concave; the land is higher within the angles, *i. e.*, to the north and east. The rest of the series has angles facing southeast and the sides convex; the land is higher to the north and west. Whether this is due to any known laws cannot be shown at present. One thing is noticeable; the escarpment enters the sea on the east, but dies out on the west. It may be that this is a case of a fault dying out at both ends, and caused by some disturbance at its center; which would probably make a symmetrical figure, not alike on both sides. However, this is mere hypothesis.

To the north of the escarpments the country is a fairly even upland, peculiarly dissected and surmounted by innumerable hills which bear northwest, more westerly than any of the offsets of the escarpments. The drainage is by lakes and small streams. The former are curvilinear, and both take in general the direction of the axes of the hills. All this apparently is due to glacial action, and the same pattern exists over all the country around. In the lowland along the south side of the escarpment series there is a line of drainage from Lake Vettern on the west to the Baltic on the east. It consists of Lakes Boren and Roxen and the estuary Braviken, with a stream connecting them.

The escarpments cannot be due to glacial action, for (1) they are neither in line with the ice motion, as shown by lakes and eskers, nor at right angles to it; (2) in cer-

tain localities the same drift is present on both sides of the escarpment, passing over the interruption, and in other places the bluff marks the boundary between two glacial formations. Whatever did cause the escarpments was local; for they are limited in extent, and besides them no others with similar alignment exist reasonably near. The only methods ordinarily found are the erosion of sedimentary strata of various resistances, and faulting. The geology of the region is that of an old-land surface, of complex structure, composed of very ancient sediments and crystallines. This could not possibly give such an escarpment by simple erosion.

The field evidence, however, leads directly to faulting as the ultimate cause of the present topography. Here the physiographer must turn to the geologist for help. But having received his answer, certain problems of erosion are thrust upon him; and he must decide whether the faulting is recent, and if not, its age and the subsequent history of the surface. These I have not found treated in the literature of the country, nor more than hinted at in conversation with Continental geologists who are acquainted with the localities.

To the south of the escarpments the rocks are Cambrian, Cambro-Silurian and Silurian sediments, with some outcrops of the pre-Cambrian crystallines close to the fault. To the north are mainly crystallines, with two outcrops of Silurian close to the bluff. In most places where the escarpments are not accompanied by a waterway the surface deposits change abruptly. In other instances no change takes place.

From the physiographic standpoint, then, it appears that the fault is an old one, of unknown date, which brought weaker Silurian and Cambrian rocks against the crystallines. The down-throw was to the south, allowing that portion of the sediments which now remains, to drop. Since then the country has been reduced to base-level at least once, and probably a number of times; and any sediments which once extended northward over the crystallines have been eroded. The last cycle of changes has included re-elevation, revival of stream action, and etching out of the present topography in the less resistant Silurian and Cambrian, giving the appearance of a recent fault.

J. Edmund Woodman.
Harvard University.

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*LIFE CONDITIONS OF THE OYSTER: NORMAL AND ABNORMAL.**

The Committee are bringing their investigations to an end for the present, and they now state in this final report a series of the conclusions at which they have arrived. The details of the evidence upon which these conclusions are based will appear in a fully-illustrated memoir by Professor Boyce and Professor Herdman, which is nearly ready for publication. A good deal of that evidence has, however, been outlined in our former reports (at Ipswich, Liverpool and Toronto), and need not be now repeated.

Since last year's report, however, we have gone further into the question of the amount of copper and iron present in different parts of various kinds of oysters, with results which sustain the conclusions we had already arrived at.

We have also gone more minutely into the question of typhoid-like organisms, their occurrence in shellfish, and the differentiation of these from the *B. coli communis* on the one hand, and from the true *B.*

* Third and Final Report of the Committee of the British Association for the Advancement of Science, consisting of Professor W. A. Herdman (Chairman), Professor R. Boyce (Secretary), Mr. G. C. Bourne, Dr. C. A. Kohn and Professor C. S. Sherrington, appointed to Report on the Elucidation of the Life Conditions of the Oyster under Normal and Abnormal Environment, including the Effect of Sewage Matters and Pathogenic Organisms. (Drawn up by Professor Herdman, Professor Boyce and Dr. Kohn.)

typhosus on the other, with the following results:

BACTERIOLOGY OF SHELLFISH.

In one of our previous reports (B.A., Liverpool, 1896) we drew attention to the comparatively frequent occurrence of a group of organisms giving the reaction of the *Bacillus coli*, and also of a motile bacillus, which, owing to the fact that it did not behave like the Colon bacillus in all its reactions—*i.e.*, formation of indol and gas bubbles, approached somewhat the *B. typhosus* type. Shortly after the publication of that paper Dr. Klein drew attention, in the very comprehensive Local Government Board Report, upon 'Oyster Culture in Relation to Disease,' to the frequency of the presence of the Colon bacillus in oysters, and in one instance to the presence of a bacillus which, after most careful investigation, could not be distinguished from the bacillus of Eberth. Since that date we have continued our investigations upon the bacteria present in oysters, and have further extended them to other shellfish. We have examined, during the last year, 19 batches of oysters, 17 batches of mussels, 18 batches of cockles, 5 batches of periwinkles and 1 batch of whelks; these were obtained from shops in various parts of Liverpool.

Methods.—The methods employed were similar to those detailed in our Report previously referred to, except that we availed ourselves of the serum reaction, and we desire to express our thanks to Dr. Christophers, who especially undertook the investigation of the serum reaction in connection with all the 'coli' and typhoid-like organisms which were isolated in the Laboratory.

Results.—Oysters.—In nine out of the nineteen batches a colon-like organism was isolated from the interior of the oysters. In some instances there was almost a pure culture of the Colon bacillus, the Petri dishes giving a very characteristic odor. The reaction in the nine cases differed; there was the typical colon group, coagulating milk, forming indol and gas, and giving a decided acid reaction, as well as an abundant growth upon potato. There was also a group consisting of very active bacilli, not coagulating milk, not forming indol, occasionally forming gas, and in two cases giving rise to a slightly acid reaction in neutral litmus whey, and in three cases to an alkaline reaction. In each suspicious case the serum reaction was carefully tried, but always with negative results. We conclude that this latter group, although giving some of the reactions of the typhoid bacillus, cannot be regarded as identical with the true bacillus of Eberth.

Mussels.—The colon group is less frequent; some of the bacilla isolated coagulated milk, formed gas and indol, whilst others gave negative reactions, as in the case of the oysters.

Cockles.—A colon bacillus was not isolated. A coccus not liquefying gelatine, growing at a temperature of 37° C., and sometimes forming gas, was frequently met with.

Periwinkles.—As in the case of the previous group, a coccus was isolated.

Whelks.—From these a bacillus was obtained which formed gas at 37° C., did not coagulate milk nor produce indol, and only after four days produced a slight acid reaction in neutral litmus whey; it, therefore, resembled the second group found in the oyster.

These observations show the frequent occurrence of the Colon group of bacilli in such shellfish as we have investigated. Moreover, they clearly indicate that some of the organisms composing this group are more closely related in their reactions to the *Bacillus typhosus* than others are, although none corresponded to that bacillus

in all respects. It will be remembered that in our Liverpool Report (1896) we described the occurrence of the typhoid organism after various intervals of time in oysters which we had experimentally infected with typhoid material. To that report* we may refer also for a discussion of the results of washing infected oysters in a running stream of sea-water, and for a statement of the diminution of the number of typhoid organisms as the time of inoculation recedes. In our Ipswich paper† we had shown that oysters were able to live, and did live, under very impure conditions, and were able to make use of sewage matter as food. We also demonstrated (in 1895) by experiments that those laid down in the proximity of drains contained far more micro-organisms than such as were some distance off in purer water. Finally, in last year's report at Toronto,‡ we gave an account of the unhealthy condition of certain green oysters, of the association of the color with a leucocytosis, and of the presence of copper in the leucocytes.§

As the result of these various lines of investigation, and of the examination of oysters alive under both natural and artificial conditions on various parts of the British, French, Dutch and Italian coasts, we have arrived at the definite conclusions as to their natural history, chemistry and bacteriology, which are detailed below; and to which we have ventured to add some recommendations as to administrative and public health questions. We are convinced that all that is necessary in order that the oyster may be restored to its proper position in public estimation as a most useful, delicate and nutritious food-matter is that shellfish importing, growing and laying shall be conducted under proper supervision, and that the grounds and waters chosen for the purpose should be inspected and licensed by duly qualified scientific authorities.

* *Brit. Assoc. Rep.*, Liverpool Meeting, 1896, p. 663.

† *Ibid.*, Ipswich Meeting, 1895, p. 723.

‡ *Ibid.*, Toronto Meeting, 1897, p. 363.

§ See also *Proc. Roy. Soc.*, Vol. LXII., p. 30.

CONCLUSIONS.

1. There are several distinct kinds of greenness in oysters. Some of these, such as the green Marennes oysters and those of some rivers on the Essex coast, are healthy; while others, such as some Falmouth oysters containing copper and some American oysters re-bedded on our coast and which have the pale green leucocytosis we described in the last report, are not in a healthy state.

2. Some forms of greenness (*e. g.*, the leucocytosis) are certainly associated with the presence of a greatly-increased amount of copper in the oyster, while other forms of greenness (*e. g.*, the Marennes) have no connection with copper, but depend upon the presence of a special pigment Marennin, which may contain a certain amount of iron.

3. We see no reason to think that the iron in the latter case is taken in through the surface epithelium of the gills and palps; but regard it, like the rest of the iron in the body, as a product of ordinary digestion and absorption in the alimentary canal and liver.

4. We do not find that there is any excessive amount of iron in the green Marennes oyster compared with the colorless oyster; nor do the green parts (gills, palps, etc.) of the Marennes oyster contain either absolutely or relatively to the colorless parts (mantle, etc.) more iron than colorless oysters. We, therefore, conclude that there is no connection between the green color of the Huitres de Marennes and the iron they may contain.

5. On the other hand, we do find by quantitative analysis that there is more

copper in the green American oyster than in the colorless one, and more proportionately in the greener parts than in those that are less green. We, therefore, conclude that their green color is due to copper. We also find a greater quantity of iron in these green American oysters than in the colorless; but this excess is, proportionately, considerably less than that of the copper.

6. In the Falmouth oysters containing an excessive amount of copper we find that much of the copper is certainly mechanically attached to the surface of the body, and is in a form insoluble in water, probably as a basic carbonate. In addition to this, however, the Falmouth oyster may contain a much larger amount of copper in its tissues than does the normal colorless oyster. In these Falmouth oysters the cause of the green color may be the same as in the green American oysters.

7. The colon group of bacilli is frequently found in shellfish, as sold in towns, and especially in the oyster; but we have no evidence that it occurs in Mollusca living in pure sea-water. The natural inference that the presence of the Colon bacillus invariably indicates sewage contamination must, however, not be considered established without further investigation.

8. The Colon group may be separated into two divisions—(1) those giving the typical reactions of the Colon bacillus, and (2) those giving corresponding negative reactions, and so approaching the typhoid type; but in no case was an organism giving all the reactions of the *B. typhosus* isolated. It ought to be remembered, however, that our samples of oysters, although of various kinds and from different sources, were in no case, so far as we are aware, derived from a bed known to be contaminated or suspected of typhoid.

9. Consequently, as the result of our investigations, and the consideration of much evidence, both from the oyster-growers' and public-health officers' point of view, we beg to recommend:

(*a*) That the necessary steps should be taken to induce the oyster trade to remove any possible suspicion of sewage contamination from the beds and layings from which oysters are supplied to the market. This could obviously be effected in one of two ways, either (1) by restrictive legislation and the licensing of beds only after due inspection by the officials of a government department, or (2) by the formation of an association amongst the oyster-growers and dealers themselves, which should provide for the due periodic examination of the grounds, stores and stock, by independent properly-qualified inspectors. Scientific assistance and advice given by such independent inspectors would go far to improve the condition of the oyster beds and layings, to reassure the public, and to elevate the oyster industry to the important position which it should occupy.

(*b*) Oysters imported from abroad (Holland, France or America) should be consigned to a member of the 'Oyster Association,' who should be compelled by the regulations to have his foreign oysters as carefully inspected and certificated as those from his home layings. A large proportion of the imported oysters are, however, deposited in our waters for such a period before going to market that the fact of their having originally come from abroad may be ignored. If this period of quarantine were imposed upon all foreign oysters a great part of the difficulty as to inspection and certification would be removed.

(*c*) The grounds from which mussels, cockles and periwinkles are gathered should be periodically examined by scientific inspectors in the same manner as the oyster beds. The duty of providing for this inspection might well, we should suggest, be assumed by the various Sea Fisheries Committees around the coast.

NOTES ON INORGANIC CHEMISTRY.

THE study of the influence of chemical composition on the coefficient of expansion of glass is one that has attracted considerable attention from both theoretical and practical standpoints. According to *Nature* an interesting *résumé* is given by M. A. Granger in the *Moniteur Scientifique*. In a few cases only the expansion follows an additive law proposed by Schott. A number of substances, such as the oxids of lead, calcium, manganese, aluminum and boron, lower the dilation when added in small quantities, but raise it when the proportion is increased. Potash, soda, lithia, fluorspar, lime or calcium phosphate raise the coefficient of expansion, but except in the case of the last not more than 8 per cent. can be added, as the glass either refuses to take up more or else becomes devitrified and opaque. Calcium borate, oxid of iron, alumina and silica lower the coefficient of expansion, alumina being especially active in this respect.

A SECOND series of experiments on the action of water on metals is contributed to the last *Chemical News* by Robert Meldrum. The action on iron was noticed last week in this column. He finds that all waters tested have action on copper. Seven feet of one-sixteenth inch wire was used in each case. In five months distilled water had dissolved 0.055 parts per 100,000. Ammonia and carbon dioxid free water in 115 hours' exposure contained 0.1925 parts. A lake water containing 0.0056 free ammonia, 0.0126 albuminoid ammonia and 1.756 chlorin dissolved in 24 hours 0.099 parts. A water with no free ammonia, 0.001 albuminoid ammonia and 1.22 chlorin in 24 hours dissolved 0.023 parts copper. A town water supply with 2.07 chlorin and 3.0 organic matter dissolved in 94 hours 0.0825 copper, all in parts per 100,000. Sludge from a water tube boiler in use for some years contained 0.006 per cent. copper, showing the solvent action on copper and brass fittings. No zinc is mentioned as being present, though it is known that some waters exercise a decidedly solvent action upon the zinc in the brass, affecting but slightly the copper.

EXPERIMENTS on lead were carried out by exposing the water in pieces of new lead pipe closed at one end. Two waters were tested: one (A) of a permanent hardness of 3.2° and a total hardness of 3.3°; the other (B) of permanent hardness 5° and total hardness 18.6°. In four hours A had dissolved 3.97 parts per 100,000 and B 0.049. When containing a small amount of carbon dioxid the solvent action was unchanged, but when almost saturated with carbon dioxid the solvent action of A was after the first half hour greatly increased. When saturated with calcium bicarbonate the solvent action was greatly decreased and when water A was agitated with calcium carbonate and then filtered, it ceased to have any solvent action. These experiments bear out the generally accepted view that hard waters take up little lead from lead pipes, but that soft waters and highly carbonated waters dissolve considerable quantities.

CONTINUING his investigations of the recently prepared crystallized calcium, Moissan describes, in the *Comptes Rendus*, its action upon nitrogen. In the cold no action takes place; at a gentle heat nitrogen is slowly absorbed; at a low red heat the calcium burns in nitrogen. In these two cases calcium nitrid is formed, of a bronze-yellow color. It is probable that the yellow color previously attributed to metallic calcium is due to the presence of more or less calcium nitrid. The calcium of Moissan is a white metal. Calcium nitrid is violently decomposed by water with the formation of ammonia and calcium hydroxid. It reacts

with carbon in the electric furnace, giving calcium carbid. Moissan suggests that calcium nitrid might possibly have some industrial importance in the formation of ammonia from atmospheric nitrogen.

IN the November number of the *American Chemical Journal* Professor Mallet describes an effort made to prepare what Sergius Kern had announced in 1877 as a new metal in platinum ore and named davyum. The metal possessed peculiar interest from its supposed atomic mass of 154, thus being a representative of a hitherto unknown group of platinum metals, lying intermediate between the two groups ruthenium, rhodium, palladium and osmium, iridium, platinum. Following Kern's directions and using residues furnished by Mr. George Matthey, of Johnson, Matthey & Co., Professor Mallet obtained a small residue, which agreed very closely with Kern's description of davyum. A careful examination showed that it was not elementary, but was composed of rhodium and iridium with a trace of iron. Thus the existence of an element davyum must be considered extremely doubtful.

IN the same journal Professor Keiser makes a contribution to the literature of the quantitative synthesis of water. In his experiments the hydrogen, oxygen and water formed were all weighed directly. His results give for the ratio of atomic mass of hydrogen to that of oxygen 15.874 when calculated from the ratio of hydrogen to oxygen used, and 15.886 when calculated from the ratio of hydrogen used to water formed. The mean 15.88 is thus very close to Professor Morley's figure of 15.879.

J. L. H.

CURRENT NOTES ON ANTHROPOLOGY.

EGYPTIAN ORIGINS.

A RUSH of papers has recently appeared discussing the origin of the ancient Egyptians. Most of them were suggested by De Morgan's work and excavations. A brief review of these, by Henry de Morgan, is in the 'Proceedings' of the American Numismatic and Archæological Society (fortieth meeting, 1898). Few of the writers altogether subscribe to De Morgan's theory of Asiatic origins. In *L'Anthropologie* (1898, Nos. 3 and 4) M. de Bissing, in a lengthy critique, condemns it as hasty and unfounded, claiming the elements of Egyptian civilization to be distinctly African. The distinguished Russian, Professor Anoutchine, and Schweinfurth, the traveler, both maintain that early Egyptian culture descends directly from the local neolithic period, and, while borrowing from Asia, was in no fair sense derived from that continent. This, too, is the position of Dr. E. Fraas, published in the *Correspondenzblatt* of the German Anthropological Society.

It is safe to conclude that De Morgan has by no means convinced his most competent critics.

YUCATECAN RUINS.

THE imposing ruins of a town known to the Indians as Xkichmook lie in a rocky valley about fifty miles east of Campeche. An accurate and fully illustrated report upon them by Mr. Edward H. Thompson is given in Volume II., No. 3, of the Field Columbian Museum publications. They consist of ten separate edifices of cut stone, mounds, terraces and reservoirs. Mural paintings are frequent, but mostly obliterated; incised figures are comparatively rare. Pottery is abundant, and also chipped stone implements; while polished stone objects are scarce. Obsidian is slightly represented, and metals were not exhumed.

The principal structure, called 'the Palace,' is an edifice of note. It towers eighty feet above the surrounding level, and its massive walls loom up like the face of some grim fortress.

SLAVIC ANTIQUITIES.

Professor Dr. Lubor Niederle, of the University of Prague, is widely and creditably known as one of the leading Slavic anthropologists; and it is quite appropriate, therefore, that he should appear as editor of a journal devoted to the collection of works and essays on Slavic archæology (*Vestnik Slovanskych Starozitnosti*), the first number of which has recently been issued. Its articles are printed either in Czech, Russian, German, French, English or Latin, as a learned Slav is quite indifferent to such a trifle as languages. They offer careful reviews and synopses of the contributions to this branch from all the avenues of scientific literature. The journal is so useful that it will surely be well patronized by the Slavonic antiquaries.

ANCIENT LABOR UNIONS.

A powerful social force, which the ethnologist is apt to overlook, is that of the commercial and labor unions which we call 'gilds.' An excellent illustration of their influence in early society is presented in an article by Professor E. W. Hopkins in the *Yale Review* (May and August, 1898). He studies them as they have existed in India for nearly 3,000 years. In the Laws of Manu the rules of the gilds are reckoned on a par with those of castes and families. Five hundred years later they had reached such a degree of supremacy that the precept is laid down: "The king must approve of whatever the gilds do, whether it is cruel or kind!" The most rabid labor unionist of our time could not wish for more.

D. G. Brinton.
University of Pennsylvania.

SCIENTIFIC NOTES AND NEWS.

BULLETIN OF THE U. S. GEOLOGICAL SURVEY DESCRIPTIVE OF THE EDUCATIONAL SERIES OF ROCK SPECIMENS.

Perceiving that the field parties of the United States Geological Survey had, in the course of their regular work, exceptional opportunities for making such a collection, it was determined by the Director of the Survey away back in 1882 to have these parties collect duplicate type specimens of rocks, with a view to the making up of suites for the use of the educational institutions of the country for teaching purposes. Under the immediate direction of Mr. J. S. Diller, who has had the assistance, from time to time, of other geologists and petrographers, the work of collecting was begun and carried to completion and the material was segregated, numbered and described. The suites, numbering two hundred and fifty and comprising about one hundred and sixty specimens each, were about a year ago distributed to the universities, colleges and other institutions of learning which had made application therefor.

An important feature of the undertaking, however, was still unfinished when the suites were sent out, viz., a hand-book for the use of the student. This has just been printed. It comprises 400 pages of text and 65 illustrations. It is devoted in the main to descriptions, written by sixteen different specialists connected with the Survey, of the rocks comprising the collection, although it also contains chapters on rocks in general and their study, including observations on structural features, methods of physical analysis, the principal rock-making minerals and rock classification. The work, which will be a valuable accessory to a valuable rock collection, is published as Bulletin 150 of the Geological Survey series, under the title, 'The Educational Series of Rock Specimens, collected and distributed by the United States Geological Survey, by Joseph Silas Diller.' The cost of the bulletin is 25 cents, and it may be obtained by applying to the Director of the U. S. Geological Survey, Washington, D. C.

W. F. M.

THE GERMAN DEEP-SEA EXPEDITION.

Professor Chun, the leader of the German Deep-Sea Expedition, has sent to Sir John Murray some account of the progress of the work since the expedition left in August last on the steamship *Valdivia*, and this forms the basis of an article in the London *Times*. It will be re-

membered that the German Parliament voted 300,000 Marks towards its equipment. Additional grants will be made to cover further expenses and the cost of publishing the scientific results. Professor Chun is accompanied by a staff of eleven scientific men, each of whom receives eight Marks per day from the Government, and their lives are insured for 30,000 Marks each.

The route to be followed may be divided into three portions: (1) From Hamburg round the north of Scotland to the Canary Islands, past the Cape Verd Islands, touching at the mouth of the Cameroons and Congo Rivers and Walfisch Bay to Cape Town; (2) from the Cape of Good Hope the Agulhas Bank will be examined, thence the expedition will proceed southwards past Prince Edward Island to the edge of the Antarctic ice, returning northwards through the center of the Indian Ocean to the Cocos and Christmas Islands, and thence to Padang, in Sumatra; (3) from Padang to Ceylon, thence calling at the Chagos, Seychelles and Amirante groups to Zanzibar, returning home by Sokotra, the Red Sea, Suez Canal and the Mediterranean.

The results so far obtained are of great interest to naturalists and oceanographers. Serial temperature observations were taken in the warm and cold areas of the Faröe Channel, respectively south and north of the Wyville-Thomson Ridge, which separates the ice-cold polar water flowing southwards from the warm Atlantic water flowing northwards. Regular observations were made on the specific gravity of the surface waters, and, as opportunity offered, on that of the deeper waters, also on the density, color and transparency of the water, and on the direction of the surface currents. A meteorological register is kept, in which observations are entered every four hours day and night, and self-registering instruments give continuous records of the barometric pressure, the temperature and humidity of the atmosphere. In the chemical laboratory the gases and chlorine contained in many deep-sea waters have been determined.

The samples of deep-sea deposits are collected and preserved by the chemist under Professor Chun's personal supervision. In some of the deposits the bacteriologist has observed many forms of bacteria, and in the samples of water from the greater depths various species of bacteria have also been found. The dredgings and trawlings, and the observations with closing nets in intermediate waters, have yielded results of the greatest importance. The closing tow-nets and large vertical nets have been used with remarkable success. Many deep-sea crustaceæ and fishes, which were taken in the dredge and trawl by earlier expeditions and were, therefore, supposed to live on the bottom, have been proved to live a pelagic life, floating or swimming in the intermediate waters. The botanist is paying special attention to the contents of these closing nets, with the view of determining to what depth below the surface living diatoms, peridiniæ and protococcaceæ descend.

On the way to the Canary Islands observations were made in the neighborhood of the Josephine and Seine Banks, which rise steeply from the ocean bed to within less than 100 fathoms beneath the surface of the North Atlantic. Around the Seine Bank series of soundings and temperatures were taken, and the dredgings showed a great abundance of crinoids (*Antedon phalangium*), hydroids and antipathids. The expedition proceeds from the Canaries, by way of the Gulf of Guinea, to the Cape of Good Hope, Cape Town being reached early in November, and before it sails towards the Antarctic ice the Agulhas Bank will be systematically explored. This expedition may be regarded as to some extent preliminary to the Antarctic expedition which will leave Germany in 1900.

GENERAL.

THE American Humane Society meets in Washington next month and it is expected that it will attempt to secure the passage of the vivisection bill now pending in the Senate. It is important that men of science and physicians should use their influence, especially by direct communication with their respective Senators, to prevent the passage of a bill that will interfere with the progress of science in the District of Columbia, and which may exert a harmful influence throughout the country.

THE Hurley Bill, providing for the adoption

of the metric system of weights and measures in the United States and its compulsory use in all government transactions except the completion of surveys of the public lands, will be brought up in the approaching session of Congress. The bill, it will be remembered, was defeated by only three votes in the 54th Congress and the increased interest in the foreign trade of the United States seems likely to influence its passage this winter. Scientific societies and men of science should exert such influence as they possess to call attention to the importance of the measure.

THE American Chemical Society will hold its winter meeting in New York City, beginning on December 27th.

THE eleventh winter meeting of the American Geological Society will be held in New York City, beginning on Wednesday, December 28th, in the geological lecture room, Schermerhorn Hall, Columbia University. The Council will meet on Tuesday evening, at the Endicott Hotel, the headquarters of the Society, and also Wednesday morning. The Society will be called to order by President Stevenson at 10 o'clock a. m. The President's address will probably be given on Wednesday morning, and the usual subscription dinner will be on Thursday evening. The list of papers will be mailed to Fellows on December 6th.

THE Biological Laboratory of the United States Fish Commission at Woods Holl will be open throughout the winter to those who may desire to avail themselves of the opportunities afforded for investigation in maritime zoology and embryology. Several of the winter fishes have already begun to breed, and the surface fauna is materially different from that of the summer months. The Laboratory is provided with steam heat, and a limited number of rooms in the residence are available. Applications should be addressed to the Director, Dr. H. C. Bumpus, Woods Holl, Mass.

IN connection with the approaching meeting of the New York State Science Teachers' Association it is proposed to hold an exhibition of pieces of apparatus useful in teaching science. Those who wish to examine special instruments are requested to communicate with Professor R. E. Dodge, Teachers College, New York, and efforts will be made to have the instruments on exhibition.

THE annual convention of the Association of Agricultural Colleges and Experiment Stations met last week in Washington.

MR. STANLEY FLOWER, of the King of Siam's Museum, at Bangkok, has been appointed Superintendent of the Cairo Zoological Gardens.

DR. MARCUS S. FARR has been appointed curator of the zoological collection of the New York State Museum, University of the State of New York, Albany.

A BUST in relief of the physiologist, G. von Fleischl-Marxow, who died in 1891, has been unveiled in the Court of the University of Vienna.

AT a meeting of former instructors, fellow students and students of the late James Ingram Peck, at John Hopkins University on November 5th, the following resolution was adopted.

Whereas we cannot forget that James Ingram Peck exemplified in his own life all those high qualities of enthusiasm for truth, of devotion to scientific research and of earnestness in the instruction of others, which it is the chief aim and best reward of a university to diffuse among men :

We, therefore, resolve that :

While we mourn the untimely loss of one who had been the earnest and faithful pupil of some among us, the enthusiastic and inspiring fellow student or the patient, kindly and helpful teacher of others, we are glad to remember his devotion to the highest and best work of a learned man and his success in handing on to his associates his unselfish enthusiasm in the pursuit of truth.

EDWIN A. KIMBALL, an inventor and mechanical expert formerly superintendent of the mechanical department of the University of Illinois and the Illinois Industrial Home for the Blind in Chicago, died in that city on November 14th, aged 64 years.

WE have also to record the death of M. Alexander Pilliet, Curator of the Musée Dupuytren, the anatomical museum of the University of Paris and well known for his contributions to morbid anatomy. He died in Paris on November 2d, at the age of 38 years.

THE death is announced of John W. Keely in Philadelphia, on November 18th. Mr. Keely,

as is well known, secured great notoriety and a considerable amount of money by a mysterious motor, a description of which has never been given in intelligible terms.

THE Royal Geographical Society, London, has subscribed £5,000 towards the British Antarctic Expedition.

A NUMBER of British and American residents in western China have, as we learn from the London *Times*, addressed a memorial to Lord Salisbury on the obstacles to and delays in communication between the upper and lower waters of the Yang-tsze. These are, the memorialists say, not only a hindrance to trade, but also a danger to the lives and properties of missionaries and others resident in the interior, on account of the difficulty of affording proper protection against rioters. Mr. Little's experiences have proved that the rapids are navigable, but they also show the necessity of a careful survey of the river from Ichang upwards before steam communication can become regular and profitable, and hence the memorialists ask Lord Salisbury to consider the propriety, in the interests of British residents and British trade in western China, of instituting such a survey by naval experts at an early date.

DR. CHARLES F. MILLSPAUGH, curator of the botanical department of the Field Columbian Museum and lecturer in the University of Chicago, is about to leave New York in the yacht *Utowana* for the coast of Yucatan with a view to studing the flora of the interior of the country. This is Dr. Millspaugh's fourth expedition to Yucatan.

A NEW steamship, *Pathfinder*, for the U. S. Coast Survey will be launched on December 7th. It was designed especially for work in Alaskan waters and is said to be the finest vessel ever built for work of this character.

ON recommendation of the Franklin Institute the Board of Directors of Philadelphia City Trusts have awarded medals purchased by the John Scott fund to John W. Hyatt, of Newark, N. J., for his elastic spiral anti-friction roller; to Melvin L. Severy, of Arlington Heights, Mass., for his impression process, and to Henry Lyman Sayen, of Philadelphia, for his improvement in Röntgen-ray tubes. The income of the medal fund, which was created in 1816, is willed by the testator "to be laid out in premiums to be distributed among ingenious men and women who make useful inventions, along with which shall be given a copper medal."

THE Paris *Temps* states that Professor Grassi has discovered in the laboratory of the hospital of Saint Esprit, at Rome, the bacillus of malaria. Its host is said to be an insect of the mosquito family.

SURGEONS Wasdin and Geddings, who have spent about a year studying yellow fever in the South, have been sent to Havana to continue their studies there. Their previous work has, it appears, to a certain extent, confirmed the researches of Sanarelli.

THE commission to be sent by the British government to India to investigate the plague, to which we recently called attention, has now been appointed and consists of Dr. Thomas R. Fraser, F. R. S., professor of materia medica and clinical medicine at Edinburgh University, who has accepted the duty of President, and with him will be associated two other scientific experts, Dr. Wright, professor of pathology at the Army Medical School, Netley, and Dr. Rüffer, who has been for some time head of the Egyptian Sanitary Department at Cairo. Two officers of the Indian Civil Service, Mr. J. P. Hewett, C. I. E., and Mr. A. Cumine, both of whom have have had much to do with recent plague affairs in India, have also been appointed to the commission by the government of India. The scope of the commissioners' inquiries will include: (1) the origin of the different outbreaks of plague; (2) the manner in which the disease is communicated; (3) the effects of certain prophylactic and curative serums that have been tried or recommended for the disease. The members of the commission will reach Bombay towards the end of the present month.

THE plague in Bombay is showing some abatement, the deaths during the last week in October having decreased to 96. In the Presidency of Bombay no less than 5,000 deaths occurred during the week, and an increase has occurred in the Mysore state, 400 deaths being recorded in Bangalore alone. It is supposed

that there is a serious outbreak of the plague in the Samarkand district, the Russian government having sent thither 40 physicians, but no details can be obtained. An isolated case has occurred in Warsaw.

The British Colonial Office has requested the Royal College of Physicians to report to it on the communicability of leprosy, and the question has been referred to a committee consisting of Sir D. Duckworth, Drs. R. Liveing, Payne, Hebb, Heron and J. Anderson, with power to confer with others not belonging to the College.

Nature quotes from the *Sydney Daily Telegraph* of September 9th particulars as to the coral-boring operations at Funafuti, news having been received via New Zealand, through the U. S. S. Co.'s steamer *Poherua*, which coaled H. M. S. *Porpoise* at Funafuti, as to the progress of the two bores, one on land, and the other in the lagoon of that coral atoll. With regard to the lagoon bore, operations were commenced on August 15th, Commander Sturdee having succeeded in mooring the warship so taut that it was possible to work the boring pipes without risk of their bending or breaking from the bows of the warship. Mr. G. H. Halligan, who is in immediate charge of the boring plant, reports that for the first twenty-four hours of boring a depth of 109 feet was attained, the total depth of the bore being 212 feet below the water level of the lagoon, the depth of water to the bottom of the lagoon being 103 feet. The *Poherua* left at the end of the first day's boring. As regards the nature of the material bored, Mr. Halligan states that the first 80 feet below the bottom of the lagoon were formed of sand, composed of joints of Halimeda (a seaweed which secretes a jointed stem of lime) and of fragments of shells. The remaining 29 feet were in similar material, but containing small fragments of coral getting larger at the deeper levels. The deepening of the old bore, discontinued last year at a depth of 698 feet, on the main island of Funafuti, has been proceeding slowly but steadily. The party were landed there by the London Missionary Society's steamer *John Williams*, on June 20th last. As was anticipated, little difficulty was experienced in redriving the lining pipes into the old bore and washing out the sand and rubble which had choked the bore hole. Pipes were laid from the site of the old bore to some small water-holes, from which a supply of fresh water was obtained for the boiler. By July 25th, the relining and cleaning of the boiler having been successfully accomplished, boring was resumed, and up to the time when the steamer *Poherua* left, a depth of 840 feet had been reached. The bore last year terminated in soft dolomite limestone at 698 feet, but it has now been ascertained that below this is a hard rock, so hard that the portion of the bore-hole which penetrates it no longer needs to be lined with iron pipes, a condition which must facilitate the work of boring. Mr. A. E. Finckh reports that this hard rock is largely composed of corals and shells. The depth of 840 feet is exactly the crucial depth which it was hoped the bore might reach, and, if possible, exceed, as at a corresponding depth on the ocean face of the reef there is a strongly marked shelf, as shown by the soundings by Captain A. Moysten Field, of H. M. S. *Penguin*, and it is considered that this shelf, at the 140 fathoms' level, marks the downward limit of the coral formation.

The Department of Agriculture of the Cape of Good Hope has issued, according to *Natural Science*, 'The Report of the Marine Biologist for the year 1897,' by Mr. J. D. F. Gilchrist. In the report for 1896 and in the present report reliable information has been published relative to the fishing industry and fishing centers of the colony. The colonial government is now in a position to appreciate the value of this important industry and the possibilities of its development, and to legislate on matter which may arise in regard to it. In order to satisfactorily investigate the fishing grounds one of the most modern types of steam vessels was procured, together with a skilled crew, and they set to work with long lines, nets and trawl. So far it is found that there is within easy reach of Cape Town an excellent trawling ground, rivalling the North Sea in productiveness, and among other excellent fish, soles occur there abundantly, some of them turning the scales at 8 and 9 pounds, from near St. Helena Bay. The future work of the *Pieter Faure*, as the

vessel is called, will be the investigation of the Agulhas Bank from Mossel Bay and Port Elizabeth, Knysna, Port Alfred and East London. The scientific aspect of the work will be kept in sight, but for the present more attention must be given to the industry. Considerable opposition has been made to the operations of the steam trawler, but it has been pointed out that Parliament was only experimenting at present, that proper investigation would be made into the alleged disturbance of spawn and the fishing limits for ordinary fishermen, but that the store of food available round the coast would certainly be exploited in a country clamoring for cheap food, and that the interests of a large country would outweigh the interests of a few individual fishermen. The report contains some valuable charts, descriptions of a new *Arnoglossus* by Mr. Boulenger, and a new genus of gasteropoda *Neptuneopsis gilchristi* by Mr. G. B. Sowerby, besides much other statistical information.

A LARGE number of visitors, as we learn from the London *Times*, assembled at the shipyard of Messrs. W. G. Armstrong, Whitworth & Co., Walker-on-Tyne, on October 29th, to witness the novel launch of an icebreaking steamer, said to be the largest in the world, which the firm has built for the Russian government. The vessel is the pioneer ship of what may be termed pelagic icebreakers. The dimensions and appearance of the vessel would suggest a battleship were it not that the bow is cut away and forms an exceedingly long overhang, which serves the double purpose of breaking the ice with which it comes in contact and of protecting the forward propeller. The principle upon which the new vessel attacks the ice is by force, augmented by science. The forward propeller, by disturbing the water under the ice, deprives it of its support, and then renders it a comparatively easy task for the heavy vessel to break through it. The principal dimensions are: Length 305 feet, breadth 71 feet, and depth 42 feet 6 inches. When fully loaded the draught will be 25 feet, and the corresponding displacement about 8,000 tons. The propelling machinery has been divided into four sets, of which three sets are aft, each driving its own propeller, and one set forward. The combined power of these four sets of machinery will be 10,000 horse-power. There is accommodation for 30 first-class passengers, 10 second-class and 50 third-class passengers, besides that for the captain, officers, engineers and crew of the vessel. There is ample capacity for cargo, so that the vessel, in addition to conveying merchant vessels through the ice, is herself capable of carrying a heavy cargo. The stern of the icebreaker is cut to form a recess, into which the stem of another vessel can be securely lashed, and thus obtain the utmost protection from her powerful consort. Admiral Makaroff has also in view the possibility of augmenting the icebreaking capabilities of this vessel by having the assistance of a second vessel pushing her, as to which he has already made experiments.

THE British Select Committee on the Museums of the Science and Art Department recommended that the collection of preserved fish bequeathed to the nation by the late Professor Buckland should be abolished. In view of this action the Piscatorial Society has adopted a request that reads as follows: The committee inspected the collection, which they found in a deplorable condition and quite inadequate to carry out the testator's intentions, evidently owing to absolute neglect since it was taken over. There being no catalogue, it is impossible to determine how much of the original collection still exists. The purchased additions apparently consist of something less than two dozen specimens, the majority of which have no direct bearing upon British fish industries. A large amount of the space allotted to the exhibit is taken up by objects which, however interesting in themselves, have no connection with either fish or fisheries. Your committee fully endorse the opinion of the Select Committee of the House of Commons as to the danger arising from the specimens preserved in spirits, as the building is certainly unsuited for the storage of such exhibits, but fail to see the point of the objection as regards the Buckland bequest, inasmuch as the majority of the fish in alcohol belong to the Day collection, which is not in any way an industrial exhibit and should be placed in the Natural History Museum. As regards the testator's intention to

provide a consulting and reference room for his fellow-countrymen, whether interested in sea or river fisheries, your committee are of opinion that such an educational center is urgently needed, and that the collection in question, although inadequate through neglect, is capable of being brought up to date and of taking the place contemplated for it by the doner. Subject to Mrs. Buckland's life interest, a sum of £5,000 was bequeathed to the Director and Assistant-Director of the South Kensington Museum, in trust for the British nation, to provide lectures on fish culture in connection with this unique series of specimens. Your committee, however, have failed to ascertain what has been done with this money. All that they know is that no such lectureship exists, despite the statement of Mr. George Bompas in his 'Life of Frank Buckland,' published in 1885, that after the death of Mrs. Buckland '£5,000 was given to found a lectureship.'

The British Institute of Preventive Medicine, says *Nature*, which was founded with the view of establishing in this country a national home for bacteriological work in all its branches, has made considerable progress towards the achievement of this aim during the past few years. The bacteriological laboratories are now fully organized, the serum therapeutics laboratory is on a firm footing, whilst the application of bacteriology to hygiene are finding full recognition. A further addition has just been made to the departments of the Institute in response to the growing demands of the times. A large laboratory at Chelsea has been assigned to investigation and instruction in technical bacteriology. In this laboratory the agriculturist, the chemist, the brewer and others will find the instruction provided that they individually require for successfully employing the living agents of fermentation. Investigations will also be undertaken, and it is hoped that the laboratory will become a center of useful work, and promote the advancement of a line of research of the greatest importance to the industries of the country. We have had hitherto to rely upon the research work of foreign laboratories in this direction. The laboratory has been named the Hansen laboratory, in recognition of the pioneer work of the distinguished investigator, and will be under the superintendence of Dr. G. Harris Morris. The formal opening of the British Institute will take place early in the new year, when the public will have an opportunity of inspecting the provisions made for furthering the objects of the Institute. The occasion will also be marked by the issue of a fresh volume of *Transactions* of the Institute.

A Zurich correspondent writes to the London *Times* that the attention of the Swiss Federal authorities has lately been drawn to the inadequate administration of the law for the protection of birds of passage and song birds in the Canton of Ticino. In the migration seasons of the year the destruction of these birds increases to such an extent that larks, starlings, finches, the titmouse, etc., are being offered in the public markets of Lugano and Ticino for 1f. the dozen, and are served as a staple article of food even in the cheapest restaurants. The birds in their southward passage are caught by nets, decoys, snares and traps of every kind, and the poverty of the rural Italians in the district serves as an additional inducement for making a hasty profit from the wholesale destruction and capture of singing birds. The evil is notorious and one of long standing, but Swiss law forbids the use of snares, traps, nets and decoy birds, and it is hoped the Federal and Cantonal authorities will be awakened to the necessity of dealing with this systematic neglect of the law. North of the Alps bird life is well protected throughout the Cantons, and here the tameness and abundance of the birds, which so many visitors to Switzerland have noticed, are the best testimony of the value of such protective laws when effectively administered and backed up by public opinion.

UNIVERSITY AND EDUCATIONAL NEWS.

President Dwight has presented his resignation from the Presidency of Yale University on the ground that he has reached his seventieth year. The Corporation has passed a minute urging him to retain the Presidency until the bi-centenial celebration in 1901, but it is said that President Dwight will retire at the end of the present year. At the same meeting of the

Corporation Professor George H. Brush resigned the Directorship of the Sheffield Scientific School, which he has held for twenty-six years, and Dr. R. H. Chittenden, professor of physiological chemistry, was elected Director.

WE understand, though the complications and delays of the law are difficult to follow, that the Supreme Court of the United States has finally rejected the application for a revision of the distribution of the Fayerweather estate, and that the colleges may now make use of the money they have received and will soon be given the balance due them.

THE will of the late Dr. Thomas Seton Robertson, which left the greater part of his property to the medical department of the University of Vermont, is being contested by his wife, against whom he had begun two years ago a suit for divorce.

A PSYCHOLOGICAL laboratory is being fitted up at Wells College, and a course in experimental psychology will be given by Miss Washburn, professor of philosophy.

MR. SWALE VINCENT, has been elected to the Sharpey Physiological Scholarship (£150 per annum), University College, London, which carries with it the post of chief assistant in the physiological laboratory. In the annual election for fellowships in St. Johns College the two fellows chosen were Mr. R. C. Maclaurin, (mathematics) and Mr. V. H. Blackman (botany).

PROFESSORS BEEBE AND PIERPONT have been promoted from assistant to full professors of mathematics in Yale University. In the same University Dr. G. P. Eaton has been appointed assistant in osteology in the Peabody Museum.

AFTER listening to a report on the condition of commercial education at home and abroad the New York Chamber of Commerce has, according to *Bradstreet's*, adopted resolutions advocating measures looking to the improvement of such education in the United States. Premising that the conditions of modern commerce and industry require wider knowledge and higher education on the part of business men, the resolutions declared that the present educational facilities afforded to business men in business colleges and similar institutions are inadequate and fail to equip them for competition in the world's commerce. The chamber went on record as favoring the establishment and development of sounder commercial education, both in secondary schools and higher institutions of learning throughout the country. The appointment was directed of a special committee to inquire further into the subject of commercial education, the committee being instructed to lay before the Chamber such plans as might best aid in attaining the end proposed. The superintendent suggested the inspection of commercial high schools by representatives of the Chamber, and the submission to such representatives of the courses of study prescribed there.

DISCUSSION AND CORRESPONDENCE.

MEASUREMENTS OF PRECISION.

TO THE EDITOR OF SCIENCE: A communication in the current number of SCIENCE under the caption 'Measurements of Precision' and over the letter 'X' seems to call for some reply. I suppose that it is generally the case that the director of a laboratory assumes responsibility for articles emanating from his laboratory with his sanction—at any rate I am always willing to do so—and this is my reason for taking up this matter in place of Mr. Taylor. Of the general tone of the article in question I prefer to say nothing, leaving it to less interested persons to judge in the matter. I shall content myself with replying to the criticisms and questions of the writer.

The upshot of the communication, freed from the subtle vein of humor which runs through it, is that Mr. Taylor has committed the heinous offence of transcribing from his note-book more figures than the results justify. Perhaps the easiest way to treat this charge is to admit it at once, and thus clear the way. I am not, however, disposed to stop there, but shall consider the statements of 'X' as they are made. The first offence is that Mr. Taylor tabulates his measurements of the diameter of a cylinder twenty centimeters in diameter to '*thousandths and ten-thousandths of a millimeter*, thus implying that his measures are made to one part in two millions.' I have always urged upon my

students that they put down everything they do, so that it may be judged how it has been done. My views are that when one puts down figures that he did not observe he perpetrates a lie, but that when he puts down figures that do not agree, or carries them too far, he simply makes himself unnecessary labor, but deceives nobody. It is easier to throw off the unnecessary figures at the end than to find out what was observed if it is not stated. I presume that this will explain the reason for Mr. Taylor's putting down the readings of the micrometers of the cathometer as actually read, that is, to a thousandth of a millimeter. It is not stated that several settings would agree to this amount, but that the figures given are the means of several settings. In the next column, in which the ten-thousandth of a millimeter appears, 'X' might have noticed, with a little more careful reading, that the last figure is invariably a five or zero, as each entry is the mean of two. I am not aware what procedure 'X' would adopt in taking means. As the result of all the measurements of the coil, the mean diameter of the coil is presented to seven figures. Now it is not a little singular that in Lord Rayleigh's celebrated paper on Clark cells, in the description of the current-weigher, of which ours is a humble imitation, the mean radius of the two coils is given to exactly seven figures, the results being 'derived from the dimensions recorded in Professor Maxwell's handwriting in the laboratory note-book.' Lord Rayleigh did not even think it necessary to unwind the coil, and it evidently did not occur to him how mortified Maxwell would have felt had he been charged by 'X' with 'implying that his measures were made to one part in two millions.' Of course, Mr. Taylor ought to have known that what Maxwell could do he could not. I charge myself with remissness in not having impressed this upon him.

With regard to the inquiry as to the maker of the cathetometer, 'of a type so extraordinary as to justify these figures,' it was a fine instrument by the Société Genèvoise, fastened to the wall, a photograph of which appears in the May-June number of the *Physical Review*. The levels upon it were by the same makers, whose names there is no motive for concealing. With regard to the statement that a degree of change of temperature would probably change the length of the bar by fifteen or twenty thousandths of a millimeter, I find that, according to Benoît's results for steel, the part of the bar used would change by about *two* thousandths, so that 'highly perfected methods of determining the temperature' were not used. We have several thermometers capable of reading half-degrees.

The culmination of 'X's' sarcasm is, however, reached in the comment on the computation of the constant, in which it is stated that the last figure stands for *one part in thirty millions* (italics 'X's'). It is a fact that Lord Rayleigh only uses seven place figures, Mr. Taylor eight. These he took from Legendre's tables, throwing off the superfluous figures at the end, where the constant is given to *four* figures, not eight. If 'X's' representation in this case be ingenuous I prefer Mr. Taylor's deception. The fact that the computation 'made by other people and a different method' gives a result differing by one part in a thousand (not in five or six hundred, as stated by 'X') does not throw any discredit on the measurements, but shows that the approximation of the first mode of *computation* was not sufficient, as is plainly stated.

I will not stop to dwell on the comments on the weighings. They are of the same sort, and may be answered in the same way. To the last figure, although observed, no weight is to be attached. The supposed 'marvelous skill' required thus disappears. But to conclude: What, it may be asked, is the use of printing a paper in which the main result, as is frankly stated, is disappointing? To this I may make a brief answer, though it is not touched upon in the communication. The subject of the determination of current in absolute measure is one that is now very much in the air. It becomes important to know what is the best form of measuring instrument, and what is the best method of computation of the constant. To this matter some of the last work of Helmholtz was devoted. The question of computation has been attacked with great vigor by Principal J. Viriamu Jones. An elaborate current-weigher of the Rayleigh type was constructed by the

English Board of Trade. On my inquiring last year how the constant had been calculated I was informed by Principal Jones that it had never been calculated at all. It accordingly seemed to me that the record of any experience with current-weighers, seriously made, would be useful, and that something might be learned therefrom. The instrument in question was constructed four years ago, as a preliminary instrument. Mr. Taylor's experiments were all made before the constant was calculated. This was unfortunate, but unavoidable. When the computation was made it was found that the design of the instrument was unfortunate. Was all the work done, therefore, to be thrown away, or should it go on record for the possible information of others? What is shown by Mr. Taylor's paper is the accuracy with which it is possible to make and measure Cadmium cells, and a determination, by a method independent of the potentionmeter method, of their value in terms of Clark cells.

In conclusion, it is only fair to state that Mr. Taylor did not invent the practice of displaying more figures than are useful. In the very last edition of Everett's 'C. G. S. System of Units' still appears the quotation of Professor Miller's comparison of the pound and kilogram, in ten figures, although comparisons of three pounds at the Bureau International des Poids et Mesures differed in the fifth figure. Colonel Clark's comparison of the meter and yard is also given to nine figures. These figures have appeared for years in every British text-book of physics. We are told that death loves a shining mark. In this he apparently differs from our lively 'X,' who, instead of turning his attention to familiar instances, seems to prefer to make merry over a man appearing for the first time before the scientific community, who will presumably not hit back.

A. G. WEBSTER
(*alias* 'Y').

CLARK UNIVERSITY, November 7, 1898.

A TRIP TO THE TERTIARY FORMATIONS OF WYOMING AND COLORADO.

THE Tertiary fossil beds of southwestern Wyoming have been of great interest to all paleontologists on account of the great beauty and the abundance of fossil fishes, plants and insects found in the shales of the Eocene period.

The fossils are darkened by much carbonaceous, organic matter, and are thus brought out in fine contrast and exquisite detail on the white, calcareous matrix.

The writer has always had a great desire to visit the locality, but found no opportunity of doing so until the past summer, when three weeks were spent in making excavations into the high bluffs to be seen from the station called Fossil, on the Oregon Short Line Railroad. The station is at an altitude of 8,000 feet. The fossil beds are nearly 1,000 feet higher, and above these beds are 200 feet of overlying rock. Much of this has to be removed to gain access to the fossils. The excavations are made on terraces, or shelves, along the face of the bluffs, and the work is quite laborious, and oftentimes very disagreeable from the dust constantly blown about by the wild winds of that region.

The locality is utterly barren and cheerless, the bluffs rising up from sand plains on which nothing grows but sage brush. Even in August and September it was quite cold, and icicles were hanging from the water tank at the station.

While on the bluff, three miles southwest of the station, we had our home in a stone house cut into the face of the cliff, the floor being the solid rock, on which we lay at night rolled up in our blankets. Every night the mountain rats swarmed in upon us, making it almost impossible to get any rest. All the water used had to be packed over from the east side of the mountain from the only spring of drinkable water in that vicinity; even this was quite alkaline. All these discomforts were cheerfully endured and compensated for, in making one of the finest collections ever obtained from that locality.

Beautiful palms and other plants, and hundreds of fishes and insects were obtained. From Fossil a trip was made into Utah, where some fine minerals were secured. After a week of rest at Salt Lake City the road homeward was taken, by way of the Colorado Midland, stopping over two weeks at Florissant, Colo., where over 700 beautiful specimens of fossil plants and insects were obtained from the

world-renowned Miocene beds of that locality. In the immediate vicinity are to be seen the petrified remains of an ancient forest. One of the stumps measured fifteen feet in diameter. The whole surrounding country shows the effects of igneous action in past ages. This is especially noticeable in the rear of the post-office in Florissant, where the granites are rent into fearful chasms, and where several deep, extinct geyser funnels may be seen, worn on the interior perfectly round and smooth by the action of water.

A trip was taken to Crystal Peak, four miles north of Florissant, where some fine Amazon stone was obtained. This completed the work of collecting, which, in every respect, has given very gratifying results.

S. Ward Loper.

Wesleyan University,
November 5, 1898.

THE PROPOSED CATALOGUE OF SCIENTIFIC LITERATURE.

In Science for October 28th there is a notice of the Second Conference on an International Catalogue of Scientific Literature, and it is said that a decimal system has been recommended.

At this critical time (before the work has been begun) there ought to be open discussion by cataloguers, and the most liberal attention given to the wishes of the users of such a catalogue. A repetition of the English catalogue, monumental but not used, is to be avoided. The most important characteristic of a catalogue of scientific literature ought to be its convenience to the user; this quality ought to prevail over all other qualities of such a catalogue. The possible wants of a user of the catalogue should be constantly thought of and provided for by the cataloguer.

The user is interested in his subject, probably not in cataloguing. He wants to find quickly and easily what has been published on a certain branch of Science. He does not want to learn a system of classification nor its method of application, as he would have to do in the case of the decimal system. He wants to find his subject in the alphabetical order, as he would in an encyclopædia; first the title, then the date, then the author and the size of the work.

The list of subjects should be derived from the titles as they are being collected, and it should be arranged in alphabetical order, for the convenience of the user.

In doubtful cases and where more than one branch of a subject is treated in a paper a title should be repeated under as many subjects as by the most liberal construction a user is likely to look for it, with too many repetitions rather than too few.

Ask the users if I am not right; and for whom else is the catalogue to be prepared?

In a case like that of the great English Catalogue of Scientific Papers, where the titles are arranged in the order of the authors' names with a number against every title, the numbers only need be collected and classified; or the numbers and the dates (though this would perhaps double the cost of publication). And here again the user should be considered by making the list of subjects large and by putting them in alphabetical order.

Alfred Tuckerman.

New York, November 5, 1898.

SCIENTIFIC LITERATURE.

Charles Darwin and the Theory of Natural Selection. By Edward B. Poulton. New York, The Macmillan Co. 1896.

This was not only a very timely book when it appeared, but will always be one of the minor classics of evolutional literature. It is well and clearly written, compact, and a most handy book of reference for the student of Darwin's life and work, by a sincere and orthodox Darwinian. Not only does Professor Poulton give us the leading facts in Darwin's life, but in a happy and skillful way he tells the secret of his greatness, when and how the fact of evolution was impressed upon him and the date when the idea of natural selection as an efficient cause was suggested to him. The two discoveries of Darwin which led him to reflect on the principle of evolution were, first, the fossil armadillos of the Pampean deposits and their relation to those now living, which led him to remark, in 1837, in his 'Naturalist's Voyage round the World:' "This wonderful relationship in the same continent between the

dead and the living will, I do not doubt, hereafter throw more light on the appearance of organic beings on our earth, and their disappearance from it, than any other class of facts." The other discovery was the astonishing diversity between the species or local varieties of the Galapagos Islands and the evident deviation of the fauna from the nearest continent. As he exclaims: "Reviewing the facts here given, one is astonished at the amount of creative force—if such an expression be used—displayed on these small, barren and rocky islands; and still more so at its diverse and yet analogous action on points so near each other." This occurrence of extremely localized forms is a matter of special interest at the present day, because it is due largely to isolation, and the case of the Galapagos Islands appears to be paralleled by the distribution of the land shells of the Hawaiian Islands, and the extremely slightly marked local varieties of the fishes of certain lakes in Indiana, those of the *Littorina littorea*, and the flat fish of the New England coast; the problem as to the causes of their origin being still a matter of discussion.

In several very interesting chapters the author tells us about the relations between Darwin and Wallace; with the former originating the discovery of the principle of natural selection, and with the latter that of the survival of the fittest, both receiving their inspiration from a common source, Malthus' suggestive book on Population. As is well known, Darwin brooded over his work for twenty years, all this period observing and collecting facts, and experimenting and testing the truth of his views, while Wallace 'thought out almost the whole of his theory' in two hours, completing his essay in three evenings.

The publication of the joint article by Darwin and Wallace, in 1858, is memorable not only in the annals of science, but in the history of morals. For the nobility of spirit and generosity shown by both of the young ardent naturalists, the fact that, instead of leading to jealousy and bitterness, it formed the beginning of a life-long friendship, and of mutual confidence and esteem between the two, is most creditable to them as men and as scientists.

The historic meeting o the Linnean Society when the joint essay was read appeared to have produced but little immediate effect. The first one to accept, in October, 1859, and by his own wide experience extend to variation in birds the principle of selection, was Canon Tristram.

The doctrine of the origin of species, as well as the principle of evolution in general, were ably supported by those intellectual giants Lyell, Hooker, Herbert Spencer, Huxley and Asa Gray, and the chapters in which the influence of these men on the acceptance and spread of Darwin's doctrines is described are not the least interesting in the book.

While the author is most sympathetic and appreciative, he becomes a grain narrow and provincial in his reference to Lamarck and his work, stating on p. 99 that the causes of evolution proposed by Lamarck are 'seriously disputed and it is possible that they may be ultimately abandoned.' On the contrary, we are now hearing, after they had laid *perdu* for a generation, a great deal about Lamarck's views as to the causes of variation, involving the influence of environment, of use and disuse, of isolation; even if we throw out use-inheritance, now in question, from a broad and catholic standpoint, we must concede to Lamarck the discovery of the fundamental causes of variation, and to Darwin and Wallace the discovery of the principles of competition and of selection.

A. S. PACKARD.

La structure du protoplasma et les théories sur l'hérédité et les grands problèms de la biologie générale. Par YVES DELAGE, Professeur a la Sorbonne. Paris, C. Reinwald et Cie., Libraires-éditeurs. 1895. 8vo. Pp. 878.

Although Professor Delage's volume was published in 1895, it is perhaps not too late to say a few words to call the attention of the American scientific public to this valuable work. Professor Delage occupies quite a unique position through the series of elaborate critical compilations which he has made. These compilations have all been much more than a series of literary studies, having all been based to a considerable degree upon the examination by the author of the material involved in his subject. We need only refer here to the many-

volumed treatise upon zoology upon which Professor Delage is at present engaged, and which promises to become one of the monumental works of its kind. The present volume is divided into four principal parts. The first deals with the facts of observation, and discusses in a comprehensive manner the morphology and physiology of the cell, of the individual, of degeneration, sex, correlation of parts, death, etc., and, under the head of 'Race,' the phenomena of heredity, variation and the formation of species. The author has read very widely and understandingly, and his exposition of the facts which he has to present is extremely clear, so that this book easily occupies a first place among those that must be consulted upon the general phenomena of biology.

The second part discusses the special theories which have been advanced by various writers conerning the interpretation of the facts reported in the first part. We find under this head, for instance, the manifold views which have been advanced concerning the interpretation of the karyokinetic figures, of the isotropism of the ovum, of the germ plasm and of telogeny. The third part discusses the general theories, and here the author's industry is most advantageously revealed, although, as it was but natural to anticipate, the attention given to French writers preponderates somewhat over that accorded to the writers of other countries. Here we find a historical review of the theories which have been advanced concerning the soul, formative force and the vital force, and a review of the historic discussion between the Spermatists and the Ovatists. We would direct attention especially to the review of the various theories which have been put forward, beginning with Buffon and continued by Darwin and many others, according to which protoplasm is supposed to contain units of living matter of minute size, to which units the vital phenomena are ultimately to be referred. Those who are not familiar with the history of this subject will be perhaps surprised to find how many and varied these theories of the constitution of protoplasm have been, and how slight a basis of observation and fact any of them have had for a foundation. The method in which the author proceeds in these analyses is very excellent. He gives first a summary of the particular theory, and then presents his critical observations upon the evidence and character of the theory itself, keeping thus his repertorial and judicial functions entirely distinct. The fourth part, which is the briefest, gives a review of the entire series of conceptions which seem to the author best founded and most coherent among themselves with regard to the manifold problems of heredity and general biology. The work closes with a valuable and very extensive bibliography. The author has carried out his purpose very successfully, and has produced a work which ought to be available for consultation in every biological laboratory.

Charles S. Minot.

Inorganic Chemistry according to the Periodic Law. By F. P. Venable, University of North Carolina, and Jas. Lewis Howe, Washington and Lee University. Easton, Pa., The Chemical Publishing Co. 1898. Pp. 266. Price, $1.50.

The authors of this text-book say in their preface: "The claim made in behalf of this book is that it takes the periodic system for its guiding principle throughout; * * * some text-books give brief mention of the law; others introduce it partially while still clinging to the old systems." How far the authors have departed from the plan thus outlined is shown by the table of contents.

The introductory chapter occupies thirty one pages. Molecules and atoms are treated on the first page, the atomic theory on the second, the gas laws and Avogadro's hypothesis on the fifth and sixth; valency and electro-chemical phenomena on the sixteenth and seventeenth, the periodic law on the eighteenth, Mendelejeff's table and the reason for accepting it on the nineteenth. Absurd as it may seem to discuss these topics before the simplest chemical fact has been demonstrated, it is unavoidable if the general plan of the book is carried out. In the following chapters the elements (74 pp.), halides (11 pp.), oxides and sulphides (103 pp.), nitrides, carbides, silicides and alloys (5 pp.), are treated with reference to the periodic law.

It must be remembered that this is an elementary text-book for beginners. The begin-

ner, after his introductory dose of theory, studies hydrogen on page 32, oxygen on page 46, but does not take up the study of water till he has studied all other common elements. He then finds on page 114, among the hydrides, the hydrides of oxygen and the customary elementary chapter on water. If the authors had preferred to regard water as an oxide of hydrogen it would have been found 33 pages farther on. Another example: Sulphur is discussed on page 50, hydrogen sulphide on page 120, sulphuric acid on page 220, nearly at the end of the book!

The present reviewer belongs to that number of chemists to whom the authors might refer in the words of their preface, as 'clinging to the remnants of past systems while introducing the law partially;' the reviewer made daily and constant reference to the law in lecture and laboratory at a time when the only text-book extant in which it received more than brief mention was Lothar Meyer's 'Moderne Theorien der Chemie.' The reviewer ventures to mention this to show that he does not underrate the value of the periodic system as a help in elementary instruction; yet it seems to him that the authors have followed the system so slavishly that their book is most unsatisfactory. The authors claim in their preface that they have obtained excellent results. Doubtless skilled teachers obtain good results by any method applied with personal enthusiasm and backed by thorough knowledge. In this case the reviewer believes that the good results were due to the ability of the authors as teachers, not to the method used.

E. R.

The Philippine Islands and Their People. By PROFESSOR D. C. WORCESTER. New York, The Macmillan Company. 1898. 8vo. Pp. xix + 529. 2 maps and 60 illustrations. Price, $4.00.

This volume is the outcome of two trips to the Philippine Islands. The first journey was made with Dr. Steere, in 1887–8, and work was prosecuted at that time for eleven months upon fifteen of the islands. In spite of many unpleasant experiences, the author and Dr. Bourns, who had been one of his companions upon the first trip, decided in 1890 to make a much longer stay in the group of islands. Upon this latter occasion they were occupied for two years and eight months with the careful study of the birds and mammals of the more important islands of the group. The volume combines the story of the two expeditions and is rich in the experiences of the author, while, as he says himself, he avoids 'talking shop,' from the biological standpoint, and in this fact consists one of the charms of the book, as a great deal of scientific information is imparted at the same time that the story of the trip is told in a very pleasant style. It is not often that the capacity for accurate description and pleasant narrative are combined as they are in this case.

The first chapter is devoted to a brief historical summary of the events between Magellan's eventful voyage and the fall of Manila last August.

The author's experiences in the city of Manila are given in Chapter II., which is largely devoted to a description of that quaint city. His diplomatic struggles with Spanish red-tape will remind any one who has happened to visit the Island of Cuba of the similarity of conditions existing in this other colony of Spain, where only the power of royal authority invoked by an order from some superior source is the means of overcoming the complaint known as the 'itching palm' so common in all that country's colonies. The author speaks quite pointedly of the tendency to provoke nervous prostration, which is induced by the inevitable delays, and closes a brilliant attack upon the whole system with the remark of a Spanish official: "In your country, time is gold; here it is boiled rice." A good illustration of the old story of Spanish official plundering is given in the case of an officer who succeeded in making a fortune of fifty or sixty thousand dollars upon an annual salary of five hundred and forty dollars.

The total land area of the group is estimated by the author at 114,000 square miles, of which the Islands of Luzon and Mindanao make up more than one-half. The author gives a very good idea of the character of the natives of each island as he takes it up in the course of the volume. Probably the most interesting, because

the most novel, is his description of the Mangyans of Mindoro.

Of the eight to ten million inhabitants the author recognizes some eighty distinct tribes; Negritos, Mohammedan Malays, pagan Malays and civilized Malays are, however, the principal groups under which they can all be classified. The Negritos occupy the bottom of the scale, and apparently are incapable of civilization. They are, however, a disappearing factor and can be neglected. The Mohammedan Malays, or Moros, however, present a very different and much more difficult problem. Any nation hoping to get on peacefully with them will find it necessary to let their religion strictly alone. They will require to be ruled with absolute justice, but with relentless firmness, and must be held in check with a strong hand for a very long time before they can be brought into anything like sympathy with our customs. Of the pagan Malays the larger proportion are harmless and docile, but there are others hostile to the whites, with the best o r asons for their dislike. They are generally, however, made out much worse than they really are. The author suggests that the best use to be made of the warlike hill-tribes is to turn them into soldiers, as has been done in India.

The only problem presented by the wild Malays is their civilization.

Where there is so much that is interesting to draw from, it is difficult to choose, but a few examples might be given, which will illustrate the state of society upon the Islands. The reply of a certain native to his padre covers the ground quite completely. This unregenerate heathen said that if he became a Christian it would cost money to be baptized, to live, to marry, to die and to be buried. In his existing state some of these more or less necessary operations cost him nothing, and he could see no advantages to be derived from embracing Christianity commensurate with the increased expense. The author's observations led him to believe that the morals of the natives improve as the square of the distance from churches and other so-called civilizing influences. The author tells a great many interesting stories, which are intensely amusing, and none of them lose anything from his method of presentation. The pages, for instance, which refer to his experience on the Island of Siquijor are unique. The story of the padre and the civet cat would do credit to Mark Twain. One can imagine better than describe the sensations of the author when, after innocently whistling one of our popular ditties, he awoke one morning to find that the band master had reduced the song to a proper score, and at the head of a dignified religious procession was marching to the cathedral with his band playing this tune at their utmost lung capacity; and now ohnny get your gun' has been added to the repertoire of the sacred music of the island.

Some idea, perhaps, may be obtained of the primitive condition of the natives of the islands from their customs. They seem to prefer their meat in the condition of Charles Lamb's cheese, ready to be led if you could tie a string to it; and one is not inclined to believe that their use of the white grubs from the Sago palm as confectionery will be universally adopted.

Ex-President Cleveland will probably be interested in the account of his canonization, as given on page 490.

The author does not find the climate to contain as many of the elements ascribed to Paradise as some of his predecessors. In fact, his own observations and the summary given of the thirteen years' series of observations, made at Manila, would lead to the inference that the climate was rather severe. This might have been expected from the tropical location of the Islands. The further complication of malaria and fevers of all sorts upon the lowlands make great portions of the Islands very unattractive as places of residence.

The important questions concerning the future of the Philippines naturally arise from the character of the five million civilized natives. These belong, for the most part, to three distinct tribes, the Tagalogs, the Ilicanos and Visayans. They have good and bad characteristics: for example; they are unfaithful to obligations of all sorts; they are refractory towards mental improvement, and they are confirmed liars, even without excuse, unless it should happen to be the æsthetic satisfaction of the use of their talents in that line. They

are said to lack originality, but this is perfectly natural under the conditions in which they have been forced to live. They are almost hopelessly indolent, but no one, not even a white man, could work there as he would in a temperate region and live. He has many good qualities, however, to counterbalance these defects in his character. His open-handed and cheerful hospitality is much in his favor. He is cleanly, both with regard to his person and his surroundings. His houses and family are well regulated. He is patient and forbearing, but when he does get angry becomes a perfect maniac. He is a kind father and dutiful son. He is genial and sociable among his fellows, and is naturally fearless.

With all these good qualities they seem, however, to be absolutely unfit for self-government, and probably their lack of education is the main difficulty in the way of their realizing this important object. They appear to be 'big children who must be treated like little ones,' but as they are naturally law-abiding and peace-loving there is some hope of them.

The natural resources and the conditions governing their development are dealt with in the appendix.

WILLIAM LIBBEY.

GENERAL.

AFTER four years a new edition of M. Ch. Féré's *La famille neuropathique* (Alcan) has been called for, and the author has used the occasion not only to revise the work throughout, but also to add much new material. A chapter is now devoted to the heredity of tumors; the discussion of monstrosities and their experimental production is enlarged as the result of new contributions, and the abundant recent literature on physical and mental degeneration is incorporated. The heredity of bodily diseases and malformations is a subject sufficiently difficult, while in the case of mental degeneration there is at present almost complete chaos. When M. Féré discusses the hereditary transmission of vice, crime and even functional disturbances of the nervous system it is impossible to be sure that what he regards as hereditary is not entirely due to environment. When he says we must spread precise ideas of the causes of degeneration, and then proceeds to give the five causes, at least half of them are extremely doubtful. It is not even certain that degeneration does obtain in modern society. M. Féré's review, is, however, on the whole objective, and is made especially valuable by the ample references to the literature. It appears from the index of names that more than 1200 separate authors are quoted, and full bibliographical details are supplied.

PROFESSOR KARL GROOS'S work on 'The Play of Animals' has been translated into excellent English by Miss Elizabeth L. Baldwin and published by the Appletons. As the editor, Professor J. Mark Baldwin, says in his preface, the volume is a contribution to three departments of enquiry—philosophical biology, comparative psychology and the genesis of art. Being thus of interest to many students, the English version will prove most useful. It is not necessary to give an account of the contents of the book, as the German edition was the occasion of a thorough critical review by Professor Baldwin (Vol. V., pp. 347–52). Indeed, then was first adequately signalized the importance of Professor Groos's work. The promised companion volume on the play of children is awaited with much interest.

WE are glad to call attention to the second edition of Dr. Verworn's General Physiology, the original edition of which has already been reviewed in these columns (Vol. II., pp. 557–8). The second edition shows many improvements upon the first, and many of the subjects which were somewhat scantily dealt with in the earlier edition are now treated more fully; but the general plan and execution of the work remains closely similar to that of the original edition, so that we hold it to be unnecessary to do more than again commend the work to the attention of American biologists, and to express the hope that general physiology, in the sense of the science of the functions of the cell, may receive in this country a much greater attention than has hitherto been the case. For this reason the translation of the work by Professor F. S. Lee, of Columbia University, announced for early publication by The Macmillan Co., will be particularly welcome.

SCIENTIFIC JOURNALS.

The Astrophysical Journal for November opens with an article on the probable range of temperature on the moon by Dr. Frank W. Very, in which the subject is taken up from its experimental side. There are short articles by Dr. J. Hartman on an interpolation formula for the prismatic spectrum; by Professor P. Tacchini on solar observations made at the Observatory of the Roman College, and by Professor E. E. Barnard on the great Nebula of Andromeda. More than half of the number is devoted to abstracts of papers read at the second Conference of Astronomers and Astrophysicists.

The November number of the *American Geologist* contains the following articles:

Geographical Phenomena resulting from the Surface Tension of Water: George E. Ladd.

The Occurrence of Copper and Lead in the San Andreas and Caballo Mountains: C. L. Herrick.

Giants' Kettles near Christiania and in Lucerne: Warren Upham.

Origin of the Archean Igneous Rocks: N. H. Winchell.

Glacial Theories—Cosmical and Terrestrial: E. W. Claypole.

Intraformational Conglomerates in the Galena Series: F. W. Sardeson.

Editorial Comment—Drygalski's Glacial Studies in Greenland.

We note with much regret the discontinuation of *Science Progress*, after the publication of seven volumes, first as a monthly and during the past two years as a quarterly review of current scientific investigation. It has been conducted by Sir Henry Burdett and edited by J. Bretland Farmer, with the cooperation of a strong editorial committee, the contributions always maintaining a high standard of excellence. The notice of discontinuation does not hesitate to emphasize the merits of the journal, remarking as it does: "*Science Progress* is admittedly the best scientific serial publication which has been issued from the English press, and it is disappointing to find that scientists generally, whilst expressing appreciation of the publication, have failed to support it by becoming subscribers. For nearly five years, relying upon its excellence, the publishers have continued the publication. The result shows, however, that at the present time scientists will not subscribe in sufficient numbers to enable a publication of the high type of *Science Progress* to be financially successful." The real difficulty has, however, been that all the sciences have been included in the scope of a single journal, and each science has often been treated in a manner too technical to be interesting or even intelligible to those who are not special students of the science. But it is unfortunate that public spirit and enlightened self-interest are not sufficiently developed to support a journal the discontinuation of which is a serious loss to science.

SOCIETIES AND ACADEMIES.

NATIONAL ACADEMY OF SCIENCES.

The Academy held its autumn meeting for the reading of scientific papers on November 15th. Twenty-seven members were present. The following papers were read:

I. Anatomy of *Nautilus pompilius*, W. K. Brooks and L. E. Griffin. (Not read.)

II. On solid solutions of colloidal glass, C. Barus.

III. Three phases of vertebrate development, Charles S. Minot.

IV. Notes on mammalian embryology, Charles S. Minot.

V. The influence of alcohol and alcoholic fluids on digestion, R. H. Chittenden.

VI. On the conditions modifying the excretion of kynuremic acid, Lafayette B. Mendel. (By invitation.)

VII. Perturbations of Minerva, with a preliminary determination of its orbit, W. S. Eichelberger, presented by Simon Newcomb. (Read by title.)

VIII. On a series of native skulls from New Guinea, O. C. Marsh.

IX. On the reputed prefrontal bones in recent mammals, O. C. Marsh.

X. Sodium tungstate as a retainer for boric acid, F. A. Gooch and Louis Cleveland Jones.

XI. The ammonium-magnesium phosphate of analysis, F. A. Gooch and Martha Austin.

XII. The chemical composition of Tourmaline, S. L. Penfield. (By Invitation.)

XIII. On the nature and origin of the marine fauna of Bermuda, A. E. Verrill.

XIV. On the ability possessed by certain animals to recover after complete freezing, A. E. Verrill.

XV. Further researches in the two isomeric chlorides of orthosulphobenzoic acid: A study in tautomerism, Ira Remsen.

XVI. On the brecciated fossil marble from Kishiu, Japan, O. C. MARSH.

XVII. On some rare antiquities from Mexico, O. C. MARSH.

XVIII. Report upon work in spectrum analysis carried on by help of the Bache Fund, H. A. ROWLAND.

XIX. Observations on the Zeeman effect with the echelonspectroscope, A. A. MICHELSON.

NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE November meeting of the New York Section of the American Chemical Society was held on Friday evening, the 11th, at the College of the City of New York, and was of unusual interest.

The first paper was descriptive of a 'New Apparatus for the Determination of Volume,' by Dr. C. F. McKenna. The instrument is designed to obviate the defects in other forms, such as those of Schumann or Candlot in respect to accuracy of readings, leakage of ground-glass joints, etc. In the apparatus proposed the powdered solid is introduced through one tube, and the reading is made on another, so slender that tenths of a cubic centimeter can be easily read and hundredths quite accurately estimated. This avoids the difficulty in reading which frequently occurs where the powdered substance is introduced through the same tube on which the readings are made.

Professor Venable, of the University of North Carolina, reviewed the 'Present Status of the Periodic Law,' exhibiting tables and calling attention to the imperfect knowledge of the elements as the cause of much, if not all, the difficulty in arranging the elements in satisfactory groups under Mendelejeff's periodic or natural system.

Mention was made of the peculiar position of hydrogen, and the light which may be thrown on it if the various new gases recently discovered shall fall into a group of which hydrogen is at present the only known member. The question as to the elemental character of the accepted elements was also touched upon in connection with the seven concordant groups. Speaking of the want of accuracy in many of the determinations of atomic weight, Professor Venable thought it quite possible that the fractional parts of these values might be of great importance, which would, of course, emphasize the need for accuracy in their determination.

Mr. R. H. Atwater read a paper on 'Chemical Glassware,' in which he took up the questions relating to the ordinary forms of glassware used in the chemical laboratory, referring to the proper form of necks, lips and stoppers of reagent bottles, engraved, etched, molded and sandblast labels, the best method of protecting the lips and mouths from dust, etc.

Referring to the nature and properties of glass, he said that glass is not usually a true salt, but a compound of true crystalline salts with an indefinite proportion of uncrystalline glass or flux. Soda glass is hygrosapic, therefore lead glass is much more satisfactory for electrical non-conductors.

In at least one factory in this country polarized light is used for testing the character of the annealing.

In conclusion, Mr. Atwater said that the American market for chemical glassware is the best in the world, and would reward the home manufacturers for making ware of as good a quality as that made abroad.

In the discussion of the paper Dr. Squibb recommended reagent bottles with loose caps over the stopper to keep away dust, and advised inverting bottles with 'set stoppers' in water over night.

A communication from the General Secretary was then read stating that the invitation from the Section to the Society at large to hold the winter meeting in New York had been accepted by the Council, and the date fixed for December 27th.

DURAND WOODMAN,
Secretary.

CHEMICAL SOCIETY OF WASHINGTON.

THE regular monthly meeting was held on October 13, 1898.

The first paper of the evening was read by Dr. H. W. Wiley, and was entitled 'Preliminary Report on the Vienna Congress of Applied Chemistry.' Dr. Wiley gave an interesting account of the proceedings of the Third International Congress of Applied Chemistry. Some of the more important papers which were pre-

sented were mentioned. The two most notable papers were those on the synthesis of albumen, by Lilienfeld, and on fermentation without cells, by Buchner. The entertainments afforded to visiting members were also described. A full report will soon be published in the *Journal of the American Chemical Society.*

The second paper of the evening was read by Dr. H. C. Bolton, and was entitled 'Chemical Bibliography.' The author described, in an interesting manner, the methods pursued by him in the collection of bibliographic references and related some of his experiences in Europe.

Mr. Tassin called the attention of the Society to a new solution for determining high specific gravities, which consists of a solution of acetylene tetra-bromide in benzol or toluol. It has the advantage of being stable, cheap and easily made, has a high refractive index and does not decompose with metallic oxides or metals.

WILLIAM H. KRUG,
Secretary.

HARVARD UNIVERSITY: STUDENTS' GEOLOGICAL CLUB, OCTOBER 25, 1898.

MR. J. M. BOUTWELL gave a paper on 'Nipissing Pass, An Ancient Outlet of the Great Lakes.' After briefly reviewing the post-glacial history of the great lakes, he described the results of a day's study of the region between Trout Lake and Nipissing Lake. Along the southern slope of the heights to the north, and overlooking the low, swampy divide between these lakes, are well developed and only slightly dissected bars, spits, terraces, and boulder-strewn beaches. These correlate with similar features, observed by Taylor, Gilbert, Spencer and others, about the upper Great Lakes, and mark the position, character, and recency of one of their post-glacial outlets.

Geological Conference, November 1, 1898. In a communication entitled 'Minerals of the Ural Mountains,' Dr. Charles Palache described the localities, occurrences, and important features of the ores, gems and rare minerals of that region. Native gold occurs in paying quantities in quartz veins which traverse the granite, syenite, metamorphic rocks and sediments older than Devonian, and also in placers, which are mainly in streams that drain eastward. Platinum is found locally in association with serpentine and chrome-iron. Chalcopyrite occurs in limited areas with an altered surface zone of malacite. Along the axis of the mountains are valuable deposits of magnetite that are associated with porphyry dikes. Siderite, with its alteration products, and manganese oxide are found as beds in the Devonian. Beryl, topaz and tourmaline occur only in pegmatites, which cut the granite, gneiss, and metamorphic rocks of the central Urals. Both are found in large, perfect crystals of the blue variety, and are used as gems. In addition to the valuable specimens of epidote, garnet, vesuvianite, perofskite, ilmenite and massive rhodenite, which occur at the contact of basic eruptives with Paleozoic limestone, this region affords several minerals that are unknown elsewhere.

Mr. J. B. Woodworth described a recent visit to 'The Glaciers of Chamonix, France.' Two phenomena, found repeatedly, were a 'shingling' arrangement of boulders in the lower, lateral moraines, due to a shoving method of deposition by the ice; and a manifest overthrusting of the upper layers of the ice, in the manner observed by Chamberlin in certain Greenland glaciers. At a point in the Glacier d'Argentière a sharp, overthrust fault showed characteristic, drag features. Current photographs fail to do justice to the height of the Alpine moraines.

J. M. BOUTWELL,
Recording Secretary.

NEW BOOKS.

Elementary Text-book of Botany. SYDNEY H. VINES. London, Swan, Sonnenschein & Co., Ltd.; New York, The Macmillan Company. 1898. Pp. xv+611. $2.25.

The Metric System of Weights and Measures Used by the Hartford Steam Boiler-Inspection Company, Hartford, Conn. 1898. Pp. 196. $1.25.

Leçons de chimie physique. J. H. VAN'T HOFF. Translated from the German by M. CORVISY. Paris, A. Hermann. 1898. Pp. 263. 10 fr.

The Living Organism, an Introduction to the Problems of Biology. ALFRED EARL. New York and London, The Macmillan Company. 1898. Pp. xiii+271. $1.75.